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PAINTED ROCKS DAM
(Also Known As West Fork of the Bitterroot Dam)

MANUAL FOR OPERATION AND MAINTENANCE

State Water Projects Bureau
Water Resources Division
Department of Natural Resources and Conservation
1424 9th Avenue
P. O. Box 201601
Helena, MT 59620-1601

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PROJECT DESCRIPTIPON

OVERVIEW

Painted Rocks Dam, also known as West Fork of the Bitterroot Dam, is located on the West Fork of the Bitterroot River in Ravalli County. The project is approximately thirty miles southwest (upstream) of the town of Darby, Montana (see Figures 1 and 2). Figure 4 provides a general layout of the dam, spillway and outlet works.

The dam is owned by the Montana Department of Natural Resources and Conservation (DNRC) and is managed by the State Water Projects Bureau (SWPB) of the DNRC. The Painted Rocks Water Users Association (herein called the "association") is responsible for repairs and maintenance of the dam.

Water from the reservoir is primarily used for irrigation and fisheries water supply. The reservoir is also used for water based recreation and the regulation of instream flow rates.

EMBANKMENT

The curved-axis earth-filled dam was completed in 1939. The dam is 143 feet high and 800 feet long. The crest width varies from 20.5 to 35.5 feet. The dam has a bridge over the spillway and a road across the top the dam embankment for access to U.S. Forest Service property.

OUTLET WORKS

The outlet works, which consists of an intake structure, tunnel conduit, and a wet-well tower is located in the right abutment of the dam. The intake structure consists of a 30-foot high concrete tower with trash racks on the tower top and on three sides. The concrete lined tunnel is a 10-foot diameter horseshoe shaped section approximately 580 feet long. The upstream 206 feet of the tunnel is founded on gravel and decomposed granite, and the remaining 374 feet go through granite. A wet-well gate tower is located about 340 feet downstream from the intake structure near the centerline of the dam. The wet-well contains two 5 ft. X 8 ft. roller gates (one operating gate and one emergency gate) with controls located at the dam crest. The gates are operated by a cable hoist mechanism powered by electric motors located in the gatehouse at the top of the control tower. There are also two air vents (6 inch and 42 inch diameter).

In 1977 and 1978, the outlet was reconstructed below the operating gate to prevent cavitation in the tunnel. The sides of the gate chamber below the gate were made straight and vertical, the floor was constructed as a ramp, and ¾ inch steel plates were placed to cover the sides and bottom. At the downstream end of the ramp section, the floor drops vertically to the tunnel floor.

The air vent was constructed in 1978 and has a 42-inch diameter corrugated pipe encased in concrete with a rectangular concrete air vent structure placed on top of the pipe. The air vent structure has a transition section from square to circular. A steel pipe was added below the transition and extends to the top of the air vent structure so that the difference in air pressure can be measured to get an estimated flow through the gate. The use of the pressure gauge is very difficult and is not used. Steel grates were placed on all four sides of the air vent structure with a manhole door on the top.

SPILLWAY

The spillway, located in the right abutment, is founded in granite rock for its entire length. The unlined approach channel to the uncontrolled concrete ogee-shaped crest is approximately 100 feet long and is crossed in front by a log boom. The crest discharges to a concrete chute, which ends in a stilling basin about 10 feet below creek level.

The concrete crest is formed in an ogee shape with approximately 12-foot of design head. The spillway crest is 160 feet wide and contains two 2.5-foot-wide bridge piers, which reduces the net spillway width to 155 feet. The spillway narrows from the 160 feet at the top to 60 feet at the bottom where it enters the stilling basin.

The stilling basin is lined with concrete and is about 150 feet long. The stilling basin floor is at two elevations; the 52-foot length nearest the spillway is 10 feet lower than the stream channel, and the remaining length is 4 feet lower than the stream channel. The width diverges from 60 feet to 125 feet. One row of chute blocks is located at the end of the spillway chute, and three rows of baffle piers are located just down-stream in the stilling basin. The baffle piers are aligned towards the outlet tunnel where the outlet tunnel exits through the spillway face. A baffle wall crosses the stilling basin 52 feet downstream from the beginning of the basin, separating the two elevations of the floor. The wall is 11.5 feet high in the center and 9.5 feet high on each end. The sides of the downstream channel are heavily riprapped.

DRAINS

There are no drains at the dam.

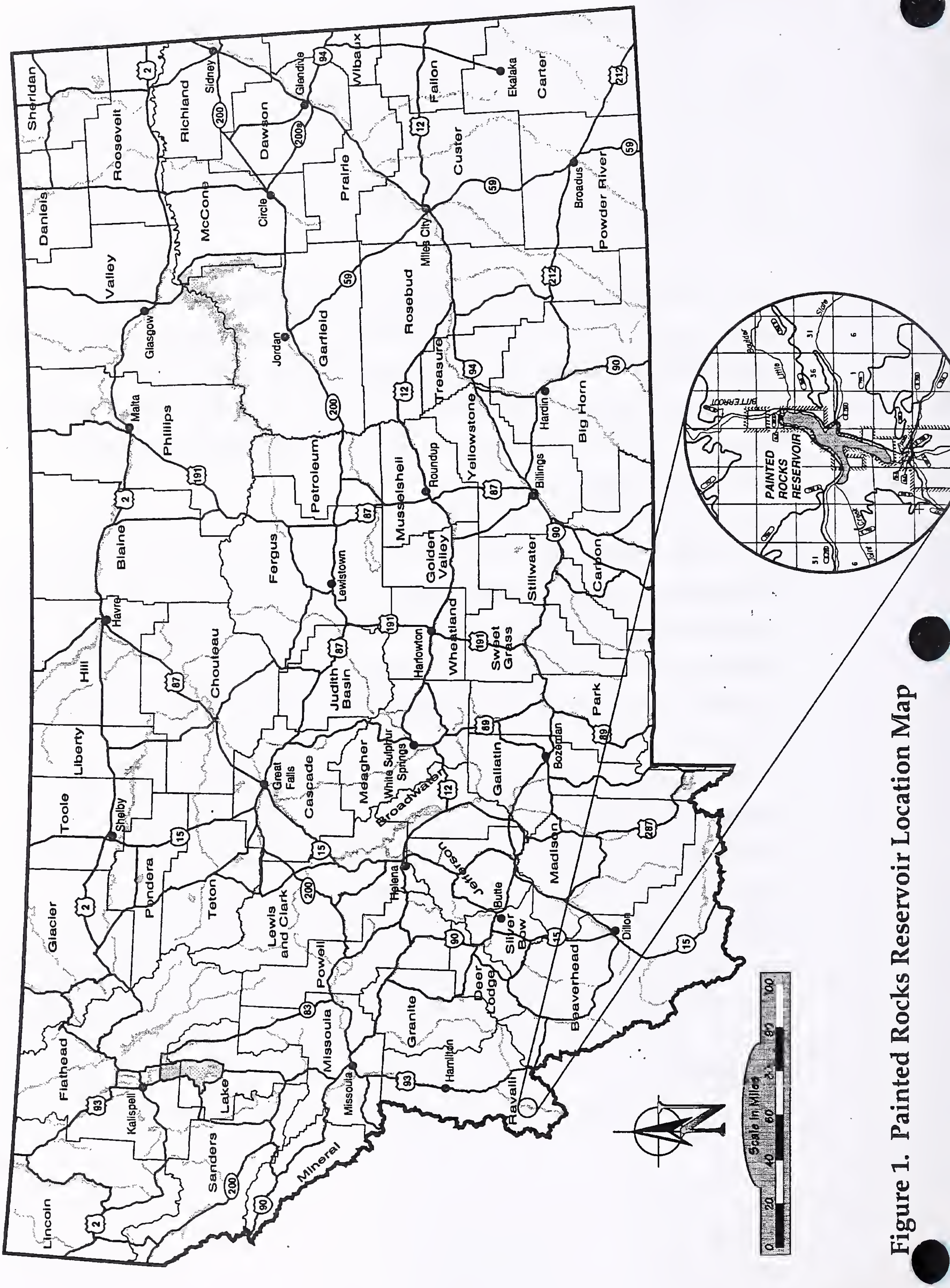

Figure 1. Painted Rocks Reservoir Location Map

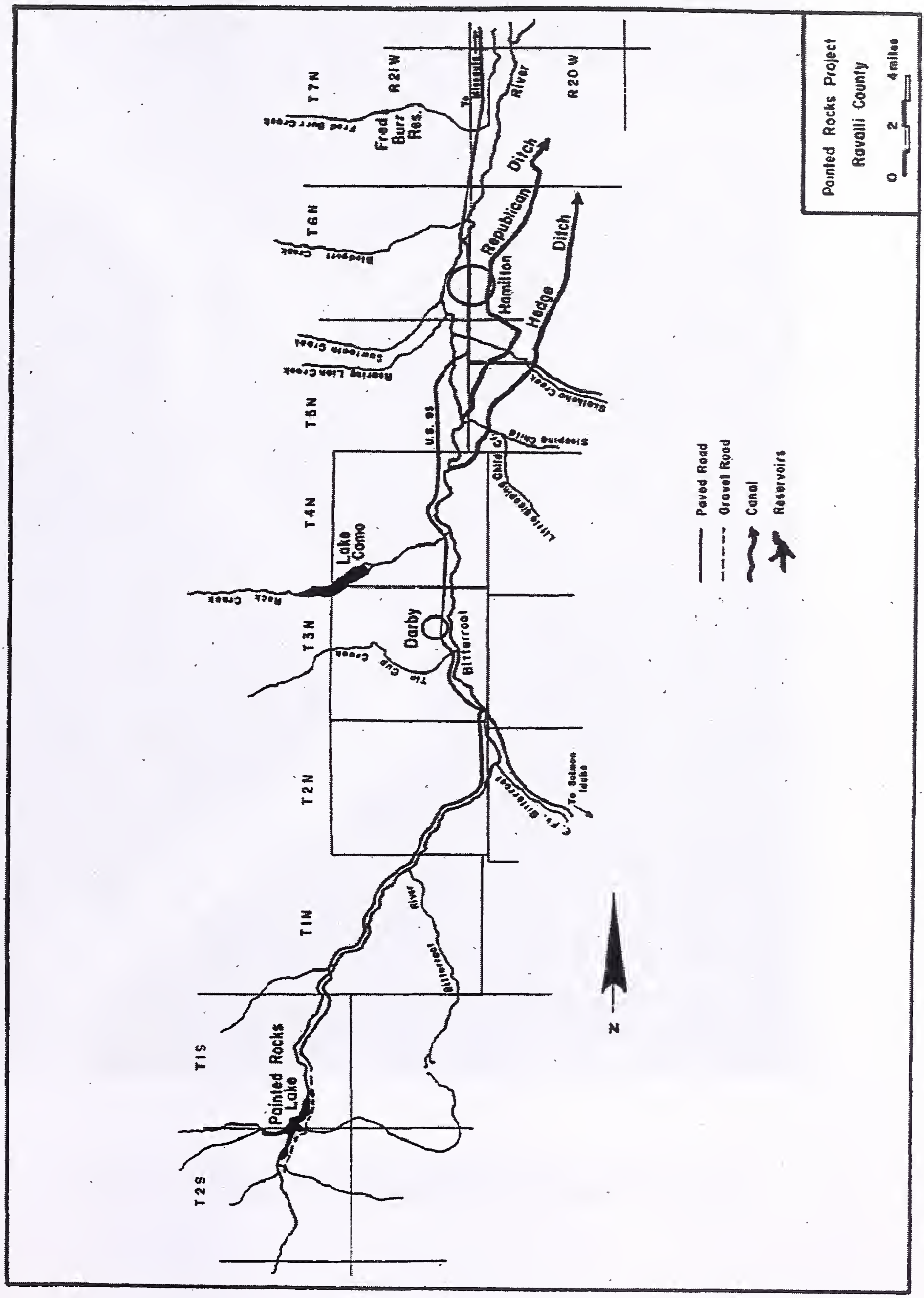

Figure 2. Painted Rocks Project Map

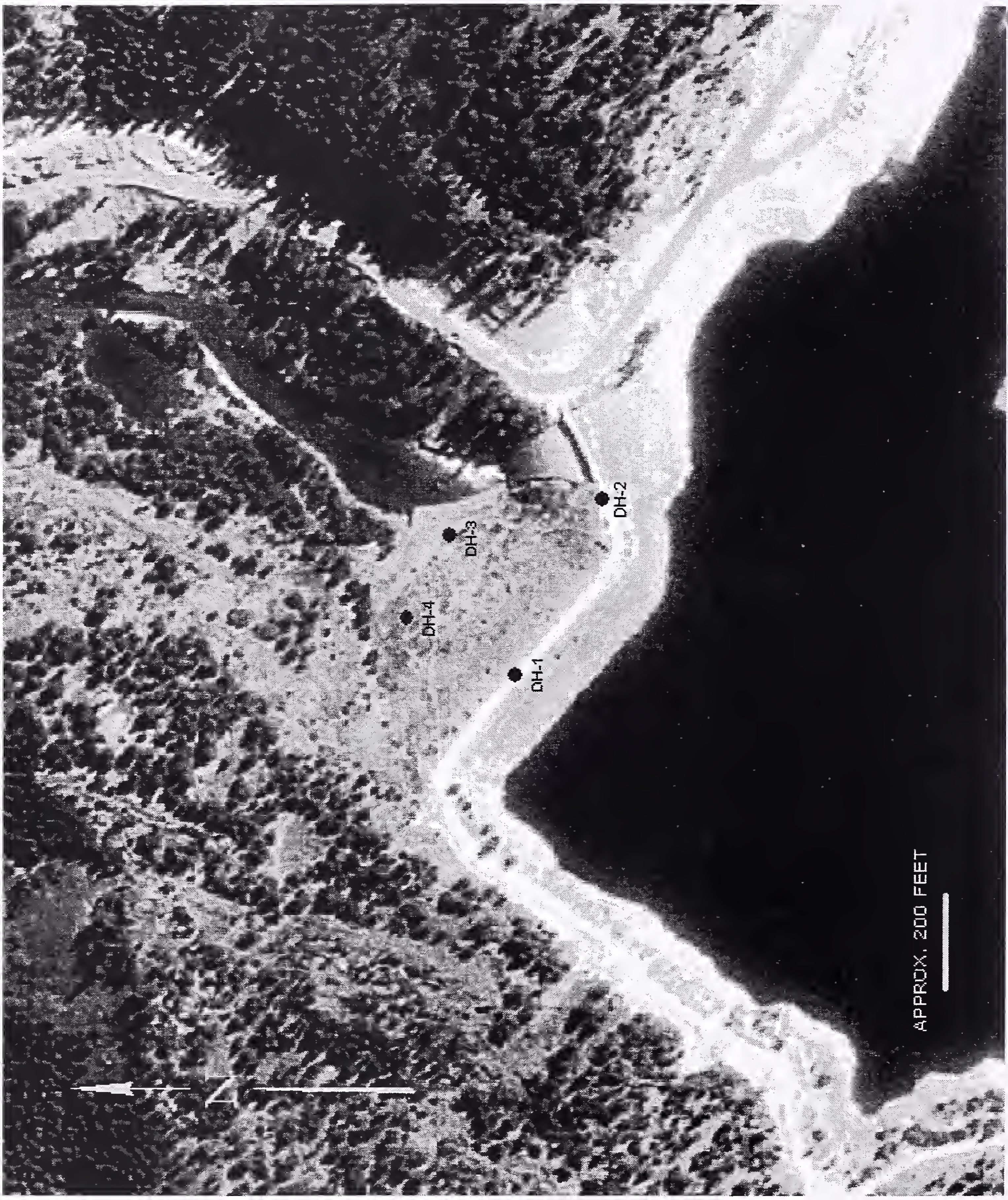

Figure 3. Drill Hole Locations

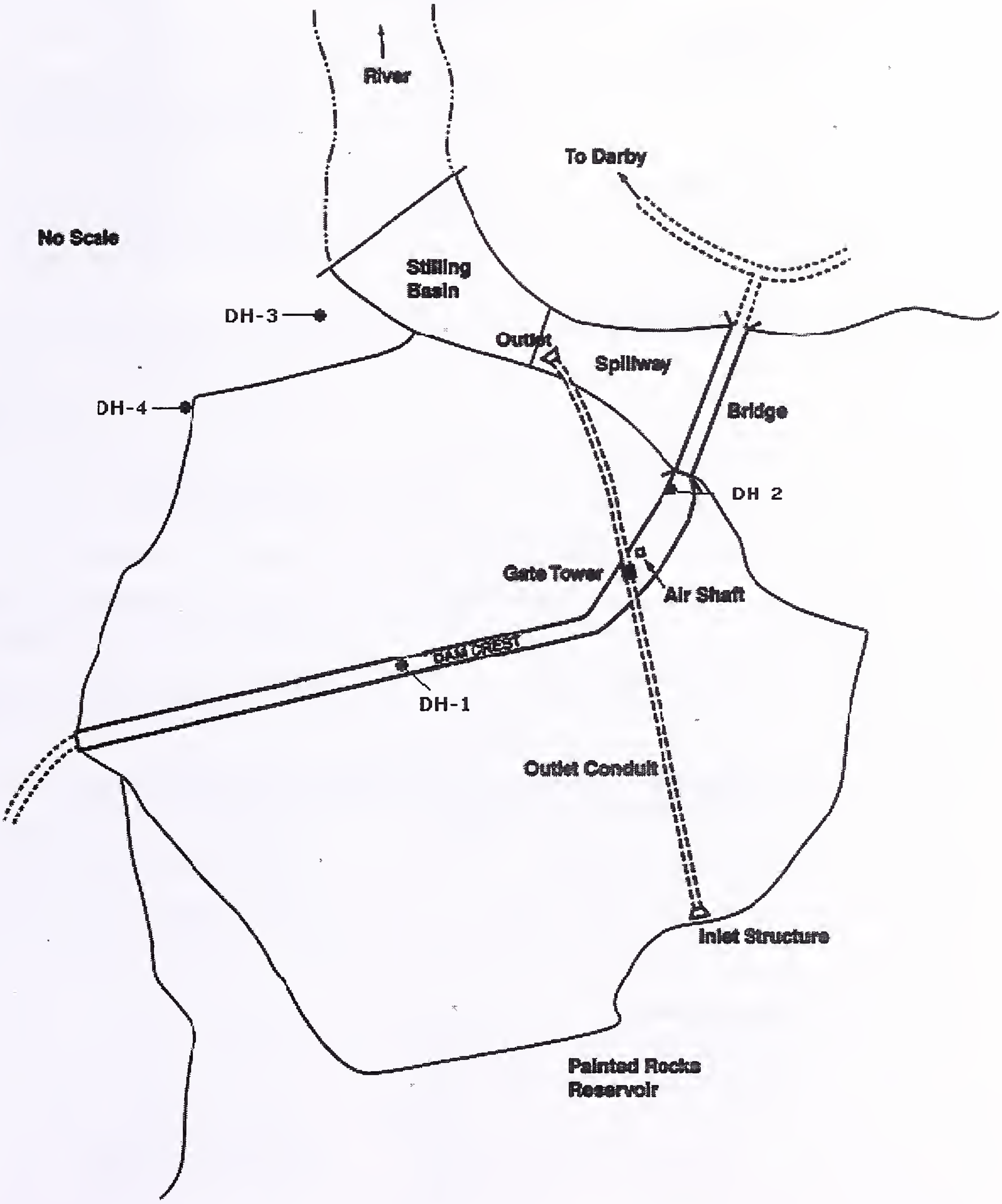

Figure 4. Painted Rocks Dam General Layout

STATISTICAL INFORMATION

1. General

a. Owner	Montana Department of Natural Resources and Conservation (DNRC)
b. Operator	Montana Department of Natural Resources and Conservation (DNRC)
c. Location	Sections 26, Township 1 South, Range 22 West, Montana Principal Meridian, 30 miles southwest of Darby
d. Latitude Longitude	45° 43' 06" 114° 16' 42"
e. County--State	Ravalli - Montana
f. Watershed Location	West Fork Bitterroot River, Clark Fork River Basin.
g. Drainage Area	316 square miles

2. Principal Elevations (feet above mean sea level)

a. Maximum Dam Crest	4,743.07 feet
b. Spillway Crest	4,725.5 feet
c. Normal Full Pool	4,725.5 feet

3. Reservoir

a. Length of Maximum Pool (approximately)	3 miles
b. Maximum Reservoir Level of Record (5/31/1995)	4,729.27 feet 34,322 acre- feet
c. Surface Area (pool at spillway crest)	655 acres

4. Storage

a. Maximum Pool (at dam crest)	45,756 acre-feet
b. Total Storage (pool at spillway crest)	32,362 acre-feet
c. Active Storage (total storage minus dead storage)	31,706 acre-feet
d. Dead Storage (pool at invert of intake structure)	656 acre-feet

Note: Maximum pool and total storage include dead storage.

5. Hydrology

a. Inflow Design Flood (Probable Maximum Flood -- PMF)	41,500 cfs
b. 100 Yr Flood	4,490 cfs
c. 500 Yr Flood	5,020 cfs

6. Embankment (Dam)

a. Type	Earthfill
b. Hydraulic Height	143 feet
c. Crest Length	800 feet
d. Crest Width	20.5 to 35.5 feet
e. Downstream Slope	1v on 2h (above elevation 4650.5 feet) 1v on 4h (below elevation 4650.5 feet and above elevation 4620.5 feet) 1v on 1.5h (below elevation 4620.5 feet)
f. Upstream Slope	1v on 2.5h (above elevation 4650.5 feet) 1v on 4h (below elevation 4650.5 feet)

7. Outlet Works

a. Size	10-feet diameter, horseshoe-shaped reinforced concrete tunnel
b. Length	580 feet
c. Gate	Two 5-foot by 8-foot roller gates (one operating gate, one emergency gate) located at the bottom of a vertical wet tower
d. Control	Gates controlled by electric motor pulley system with cables from the dam crest
e. Capacity	
Pool at Dam Crest	3,300 cfs (approximate)
Pool at Spillway Crest	3,075 cfs (approximate)
f. Design Elevation	
i. Top tower grate (lower floor elevation)	4,729.5 feet
ii. Top Intake Structure	4,635.5 feet
iii. Inlet Invert Elevation	4,625.5 feet
iv. Conduit Invert Elevation	4,605.5 feet
g. Trashrack	Yes
h. Air Vent	6-inch diameter steel pipe exits inside gatehouse 42-inch corrugated metal pipe exits outside gatehouse.

8. Spillway

a. Location	Right abutment
b. Crest Elevation	4725.5 feet
c. Type	Uncontrolled concrete chute with ogee crest control
d. Width	160 feet at crest tapering to 60 feet
e. Capacity (pool at dam crest)	42,000 cfs

9. Tunnel Vent Shaft

a. Drill shaft	48-inch diameter
b. Shaft liner	42-inch corrugated metal pipe
c. Length	103.5 feet (+/-)
d. Top elevation	4466.0 feet (+/-)
Bottom elevation	4335.5 feet (+/-)
e. Vent structure	
Size	6-feet by 6-feet square by 10 feet high made of concrete
Top	Manhole door – Type 682 - Code No. 16441 – by Flockhart Foundry Co.
Vent opening	3.5 x 4 feet on each side

10. Brief History

a. 1939-1940 Designed by the State Water Conservation Board and constructed by Frank Haas for a total cost of $400,000.00.

b. 1973 Inadequate venting resulted in cavitation around the gates. The cavitation made it difficult to properly close the gates. The reservoir was drained by The Montana Department of Natural Resources and Conservation.

c. 1975-1976 EIS for the project finalized. The EIS for the project includes an investigation of the cavitation.

d. 1976-1977 Harza Engineering designs a new ventilation tower. Frontier West is contracted to construct the ventilation shaft, repair the cavitation damage, remove the portal weir, and install a railing around the stilling basin for $330,000.00.

e. 1982 The Water Users Association remove and paint the gates. The gate cable is replaced due to wear.

f. 1987 Repair of spillway walls and floors due to spalling. (Rountree Construction $30,000.00.)

g. 1988 Pines Construction installs a new gate cable.

h. 1990 Modifications are made to the gatehouse making the roof removable for gate access.

i. 2002 New gate cables are installed. (Pennington Construction $5,077.00)

j. Cracks and concrete damage in the spillway were repaired. The spillway was sealed. (Pennington Construction $24,961.00)

k. 2003 The spillway log boom is damaged by high water.

l. 2004 Fencing is placed along the spillway. (Pennington Construction $4,916.00)

m. 2004 A new log boom is installed. (Pennington Construction $20,752.00)

n. 2004 Bore holes are drilled. Monitoring wells are installed.

o. 2005 A second motor and a motor control center are added to gate system. (Industrial Systems Corporation $22,563.00)

p. 2006 New roller chains on the upstream gate are installed. The chains are manufactured by Plesh Construction/Allor Manufacturing . Pennington Construction removes the gate and installs new chains. (Total cost :$49,637.00)

OPERATING PROCEDURES

Painted Rocks Dam is operated by the Montana DNRC. The primary operating goal of the reservoir is to provide an adequate supply of irrigation and fisheries water to meet contracts with water users without exceeding safe storage or flow levels.

DAM OPERATOR

The responsibility for the daily operation of the dam and reservoir rests with the SWPB and its dam operator. The dam operator is generally authorized to operate the reservoir to meet the SWPB's goals. The dam operator's specific responsibilities are to:

1. Operate the mechanical features of the outlet works
2. Coordinate filling of the reservoir and the release of water
3. Notify the SWPB of unusual occurrences such as impending floods, or excessive seepage.
4. Notify the SWPB when spring runoff flows have peaked and when water contract deliveries begin.
5. Perform maintenance tasks.

Typically, the out-going dam operator will train a new operator. The operator's training focuses on the mechanical operation of the gates, measurement of the storage level, measurement of the rate of water release, and record keeping.

The dam operator normally is available to observe the dam and perform operating functions as needed during the irrigation season and when the Department of Fish, Wildlife, and Parks (DFWP) calls for their contract water. Communication between the dam operator and SWPB is by telephone. The telephone in the gatehouse (406-349-3300) can be used for communication from the dam. Radio communication may be established during emergencies or unusual occurrences. **(See the Painted Rocks Dam Emergency Action Plan)**.

METHOD AND SCHEDULE OF OPERATION

Depending on snowpack, runoff patterns, and carryover storage, filling the reservoir usually starts in April or May. The goal is to have the reservoir full before the main runoff has receded to a flow where all inflow must be allowed downstream to satisfy senior water rights.

The date irrigation releases begin varies from year to year. The water delivery contracts provide that water will be available to the users between the dates of May 1 and September 30. During typical years, releases begin around June 1 and end by mid-September. The actual dates that releases begin and end depend on each year's climatological and hydrological conditions.

Water is also released from the dam (during the same dates as the irrigation water) to help regulate instream flows for fisheries. These releases are dependent upon the yearly flow conditions in the Bitterroot River.

Maximum Winter Storage: The maximum reservoir elevation for winter storage is 4,693.0 feet with 15,603 acre-feet of total storage. This winter maximum helps prevent damage to the riprap and embankment from wind-driven waves and ice.

Minimum Winter Storage: The minimum reservoir elevation for winter storage is 4,643.5 feet with 2,563 acre-feet of total storage. This winter minimum helps prevent ice damage to the inlet structure for the outlet works, minimizes water quality problems, and helps to maintain the fishery.

Minimum Outlet Discharge: To help maintain the fishery in the West Fork Bitterroot River, the minimum outflow to be maintained at the dam outlet during the winter low flow period should be approximately equal to the inflow. In a normal year, the average outflow during the non-irrigation period is 80 to 90 cfs. In recent years the outflow has been closer to 60 cfs due to low inflows. Cutting outflows to below the minimum will be allowed only as needed to accommodate necessary dam safety inspections, maintenance, drought conditions, or other emergency purposes.

September 30 Reservoir Level: The reservoir storage contents may not be drawn down below an elevation of 4,667.5 ft with 7,350 acre-feet of total storage after September 30 in any given year. All contracts will be considered satisfied when the reservoir storage reaches this level. This volume is used as a buffer so that the reservoir does not drop below the minimum winter storage of 2,563 acre-feet and expose the intake structure. At times, inflows into the reservoir may be less than the outflows from the last gate adjustment of the year.

GATE OPERATION

General: The outlet gates consist of a cable hoist operating mechanism attached to steel gates with roller chains on each side. The gate hoists are operated by an electric motor and belts. If the electricity fails, the gates can be operated manually with a hand crank.

Operating (downstream) gate: Releases should generally be regulated utilizing the operating (downstream) gate to minimize the potential for cavitation damage in the conduit. The roller chains on the operating gate do not move freely due to severe corrosion. The resulting increase in friction limits the operability of this gate during unbalanced head conditions. If fine adjustments (below 150 cfs) are required, they should be made with the emergency gate in the fully lowered position to minimize the head acting on the operating gate. An approximate change in flow of 2.4 cfs corresponds to one tooth shift on the cable drum when the reservoir is full. At approximately 16,000 acre-feet one tooth shift corresponds to 2.0 cfs change in flow. Below 10,000 acre-feet one tooth shift on the drum results in an approximate change of 1.5 cfs.

Emergency (upstream) gate: The roller chains on the emergency gate were replaced in 2006, allowing this gate to operate smoothly. There is approximately 10 cfs of leakage when the emergency gate is in the fully lowered position. The emergency gate is generally only utilized during dam safety inspections and to assist with making operating gate adjustments. During routine operations, the emergency gate should be kept out of the flow path. The gate is completely down when there is approximately 11 full wraps of the cable around the drum. The gate is out of the flow path when the drum is covered with 1-1 ½ courses of cable. The use of the emergency gate for flow regulation should be minimized.

Limitations: The maximum capacity of the outlet conduit with the reservoir at the dam crest is about 3,300 cfs. With the pool at the spillway crest, the capacity of the outlet works is about 3,075 cfs. The recommended maximum sustainable outflow through the low-level outlet works is 500 cfs. This rate can be exceeded up to a maximum of 3,000 cfs for short periods of time.

The maximum gate opening for both gates is 8 feet. However, the gates should not be opened simultaneously to the full height because the flow can cause sever damage downstream; unless an emergency exists where the full release is necessary. There is little problem in regulating large flows. However, trying to regulate small flows (less than 150 cfs) or closing the gates for inspection is where the operational problems occur. The emergency gate is normally stored at the top of the gate tower.

The outlet works are intended to be used for controlling the release of water for irrigation and fisheries, and not for providing emergency flood relief.

SPILLWAY

A physical model study of the spillway and the stilling basin was performed in 1939 prior to construction. Based on this study, the spillway chute was estimated to safely pass 30,000 cfs. In 2006, the U.S. Bureau of Reclamation evaluated the safe capacity of the spillway using numerical modeling techniques. They concluded that some overtopping of the spillway chute walls may occur at 30,000 cfs. However, they concluded that the estimated overtopping was within accuracy limitations of their study. Therefore, they concluded that 30,000 cfs is a reasonably safe spillway capacity estimate. In 1980, the U.S. Army Corps of Engineers determined that the spillway crest is physically capable of passing 42,000 cfs. However, spillway chute walls will likely be overtopped at discharges above 30,000 cfs. A rating curve for the spillway is included in Appendix B.

SAFE DRAWDOWN

To ensure stability of the upstream embankments, it is recommended that reservoir draw not exceed one foot per day. This recommended rate should not be exceeded without the approval of the SWPB.

STORAGE DETERMINATION

Reservoir storage is determined by taking slope measurements at the boat ramp located approximately 1/4 mile east of the dam. Measurements are taken on the upstream side of the concrete boat ramp. To determine the elevation of the reservoir surface and storage of the reservoir, measure in feet from the ring at the top of the boat ramp to the water surface (assumes water on boat ramp. If the water surface is below the boat ramp, measure in feet from the end of the boat ramp to the water surface). The elevation of the reservoir surface and the storage can then be found using the Slope Distance-Elevation-Storage tables (Table 1 or 2) in Appendix A.

INFLOW AND OUTFLOW MONITORING

Inflow Sites: Current inflows into the reservoir from West Fork of Bitterroot River, Overwhich Creek, Blue Joint Creek, and Slate Creek can be found using the staff gage at each site. A rating table for each site is found in Appendix A.

West Fork of Bitterroot River Site: The West Fork Bitterroot River gage site is located at the point where the river flows under the Coal Creek Road bridge. The staff gage is located on the left bridge pillar (looking downstream) on the downstream side of the bridge.

Overwhich Creek Site: The Overwhich Creek gage site is located where the creek flows under the West Fork road. The staff gage is located directly below the downstream side of the bridge and adjacent to the left bank (looking downstream) behind a 3-foot size boulder in the stream bed.

Blue Joint Creek Site: The Blue Joint Creek gage site is located where the creek flows under the Little Blue Joint Creek road. The staff gage is located on the left bridge pillar (looking downstream) on the upstream side of the bridge.

Slate Creek Site: The Slate Creek gage is visible from the West Fork road where it crosses the mouth of Slate Creek. The staff gage is located approximately 250 feet above the county road on the left bank looking downstream. Access is through the Forest Service Campground road.

Outflow Sites: Current outflows from the reservoir and flows in the Bitterroot River can be found under the Clark Fork River Basin portion of the following USGS internet site:

http://mt.waterdata.usgs.gov/nwis/current?type=flow

USGS gage 12342500, West Fork Bitterroot River near Conner, MT: This gage can be used to monitor the outflow from the dam. The gage is located on the right bank 0.6 miles downstream from the dam. The drainage area is 317 sq. mi. and the period of record is from April 1941 to the current year. The gage is a water-stage recorder and datum of the gage is 4,581.36 feet above sea level. (U.S. Forest Service bench mark). Visual gage readings can be made from the outside river gage if access into the structure is not possible. The gage reading stabilizes approximately 45 minutes after gate adjustments have been made at the dam.

USGS gage 12344000, Bitterroot River near Darby, MT: This gage can be used to monitor the flow in the Bitterroot River at Darby, MT.

USGS gage 12352500, Bitterroot River near Missoula, MT: This gage can be used to monitor the flow in the Bitterroot River at Missoula, MT.

WEATHER MONITORING

The dam operator monitors weather conditions, local weather forecasts, and the National Weather Service (NWS).

If sever flooding is anticipated, the NWS Missoula Office **(1-800-676-6975 or 406-329-4712)** should be requested to make "forecast points" of USGS gage located below the dam (USGS gage 12342500, West Fork Bitterroot River near Conner, MT). If this request is adopted, NWS will provide peak flow, storm duration, runoff duration (above base flow), and total volume flood forecast for this stream gauge as conditions warrant.

SNOTEL Sites: Current snow water equivalent and total precipitation can be monitored at two SNOTEL sites located above the reservoir -- Nez Perce Camp and Saddle Mountain. The information for these two sites can be accessed under the Bitterroot River Basin portion of the following USDA internet site:

ftp://ftp.wcc.nrcs.usda.gov/data/snow/update/mt.txt

Additional information about historical snowpack, precipitation, maps and graphs can be accessed at the following internet site:

http://www.mt.nrcs.usda.gov/swcs/snow/snow.html

INTERACTION WITH OTHER DAMS

There are no dams of any size above Painted Rocks reservoir. There are also no dams below Painted Rocks reservoir on the Bitterroot River. However, there are a number of irrigation diversion dams in the river and an irrigation siphon from Como Dam that crosses the river below the dam.

EMERGENCEY

If it appears that the Painted Rocks Dam is about to breach, or during emergency operations, the dam operator will initiate the **Painted Rocks Dam Emergency Action Plan.**

INSPECTION AND MONITORING

The SWPB inspects the dam annually. Appendix B includes an example of a SWPB inspection report form. In addition to annual inspections, SWPB or Missoula Regional Office personnel will inspect the dam and reservoir during and after heavy runoff, severe rainstorms and severe windstorms; during high storage periods; and after an earthquake.

STRUCTURAL FEATURES INSPECTION

Structural features include the outlet works, bridge, gatehouse, spillway, and dam embankment. The SWPB inspects these structures annually as part of its inspection program. Items to be checked or noted include, but are not limited to, the following:

1. Outlet Works
    a. Any differential settlement or movement resulting in cracking of the conduit
    b. Erosion of the seals or concrete by cavitation immediately downstream of the gates
    c. Major seepage of water into the conduit
    d. Deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
    e. Operation of both gates
    f. Air vent for free, unobstructed operation
    g. All metal for corrosion
    h. Hoist machinery for proper lubrication
    i. Condition of hoist cables
2. Gate House
    a. Any damage or vandalism

3. Spillway
    1. Erosion of the spillway channel
    2. Blockage of the approach or exit channel
    3. Concrete condition
    4. Condition of the log boom
    5. Stilling basin
    6. Condition of the fence on the left stilling basin wall
4. Embankment
    1. Erosion
    2. Settlement, bulges, sink holes, cracking, misalignment
    3. Riprap displacement
    4. Damage from burrowing animals
    5. Excessive vegetation, brush, trees
    6. Seepage
    7. Condition of the road across the dam
5. Bridge
    1. Deterioration of bridge surface
    2. Corrosion of steel
    3. Major structural cracking of wingwalls or abutment walls
    4. Deterioration of bearing pads
    5. Deterioration of concrete bridge support piers

RIPRAP INSPECTION

The riprap along the face of the dam should measure at least 30 (thirty) inches thick. Immediately after the occurrence of high water, the riprap should be inspected and additional riprap added if needed.

EMBANKMENT MONITORING POINTS

There are no monitoring measurement points on the dam embankment.

DRAINS

There are no drains in the dam embankment or spillway. There are several weep pipes in the spillway.

SEEPAGE

There are no reported or visible seepage areas on the dam embankment or below the dam embankment. There are a number of weep pipes located through the spillway floor that have had observable water flow. The flow amounts are small, estimated to be less than 1 gpm, and occur at high reservoir pool elevations.

MONITORING WELLS

In the fall of 2004, four monitoring wells were drilled at the dam. Two of the wells are located in the road on the crest of the spillway. Two more monitoring wells were drilled at the toe of the dam (see Figure 3). Each monitoring well has two standpipes. Soil profiles of the drill holes and well details are shown in appendix C. Levels in the monitoring wells are generally measured by the dam operator monthly. The instruments may also be measured by DNRC Missoula Regional Office, and Helena Regional Office SWPB staff.

MAINTENANCE

The SWPB, DFWP, and the association are responsible for the routine maintenance of the project. In addition, the SWPB may identify items that need maintenance or repair during the annual inspection.

ROUTINE MAINTENANCE

The dam operator will watch for and identify any potential maintenance requirements during regular visits to the dam. As soon as a need is identified, the dam operator will contact the SWPB.

Items that may need occasional attention include, but are not limited to:

1. *Lubrication and cleaning of gate-operating mechanisms.*
2. *Debris or silt plugging the inlet or the outlet channel.* Accumulated debris that could affect the operation of these appurtenances should be removed at once.
3. *Erosion gullies on embankment.* Erosion gullies should be checked immediately. Gullies should be filled, compacted, and seeded. Particular attention should be paid to the groin/abutment contact areas.
4. *Rodent damage.* Rodents will be removed or destroyed, and any burrow holes should be filled immediately.
5. *Upstream slope riprap.* The upstream face riprap normally will be observed annually, but may occasionally need repairs because of high water or wave action.
6. *Vegetative cover on downstream slope.* Good vegetative cover must be maintained. Large brush and any trees should be removed.

7. *Noxious weeds.* Noxious weeds on and around the dam embankment and around the reservoir shall be sprayed at least on an annual basis.
8. *Cleaning spillway wall tops.* Spillway wall tops should be clear of any dirt, rocks, grass, brush, and any overhanging vegetation or trees.
9. Repair of the spillway joints and sealing of cracks in the spillway.
10. *Cable.* Check the cable (wire rope) for loss of cover, fraying and wear, and replace when necessary. The cable needs to be replaced approximately every ten years based on historic maintenance.

ANNUAL MAINTENANCE

The SWPB conducts annual inspections of Painted Rocks Dam and reservoir. During these inspections, any items requiring annual maintenance will be identified and recorded. Items that may need annual maintenance are the outlet works, gates, cables, gatehouse, air vent structure, spillway, and the log boom. Other routine items needing immediate attention, such as the need to remove trees, brush, or tree roots/dead trees from the log boom will be noted.

After the inspection, the SWPB sends the Missoula Regional Office (MRO), DFWP, and the association a Dam Safety Inspection Report and a Maintenance Report. The report identifies items that need maintenance and provides a schedule of when the maintenance tasks need to be completed. The SWPB, DFWP, and the association are responsible for performing the maintenance items within the times specified.

The SWPB, DFWP, and the association may perform the maintenance tasks. However, major repair's will likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

RECORD-KEEPING

The SWPB maintains records, including photographs, of all inspections and maintenance requirements. These records also include flow measurements and storage volumes. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in Helena.

The dam operator will keep records of the reservoir elevation, seepage observation or measurements, and any unusual conditions. These records may be reviewed at the Missoula Regional Office.

REFERENCES

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Fischer, Gary, DNRC Engineer. April 20, 1993. PMF Calculations, letter.

Bureau of Reclamation. June 17 to 19, 1998. Report Of Travel Or Site Visit For Geologic Investigations. Prepared for the State of Montana (DNRC) by the BOR under the Technical Assistance to States (TATS) program.

Bureau of Reclamation. April 2006. Technical Memorandum No. MPR-8130-TM-2006-1, Painted Rocks Dam, State of Montana, Spillway Capacity Evaluation. Prepared by U.S. Bureau of Reclamation, Waterways and Concrete Dams Division, Denver, Colorado.

Stiles, C.A. Montana DNRC SWPB. January 24, 2006 Preliminary Summary Report on the Geology of Painted Rocks Dam Site Ravalli County, Montana.

APPENDICES

APPENDIX A
RATING CURVES AND TABLES

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE

PAINTED ROCKS RESERVOIR - BOAT RAMP

Pins installed and elevations established using a level in 1997.
The 0+00 pin located at the upper left (upstream) corner of the concrete boat ramp slab.
Measurements taken along the left (upstream) side of the boat ramp slab.
Storage volumes from original 1938 hand surveys+ 656 acre-feet (Dead Storage)

DISTANCE feet	ELEVATION feet	STORAGE acre-feet	NOTES
0	4,730.21	35,631	Top ring #1
0	4,729.91	35,423	Base ring #1
1	4,729.88	35,402	
2	4,729.85	35,381	
3	4,729.82	35,360	
4	4,729.79	35,339	
5	4,729.76	35,318	
6	4,729.73	35,298	
7	4,729.70	35,277	
8	4,729.67	35,256	
9	4,729.64	35,235	
9.3	4,729.63	35,228	Saw cut
10	4,729.60	35,207	
11	4,729.55	35,173	
12	4,729.51	35,145	
13	4,729.46	35,110	
14	4,729.42	35,082	
15	4,729.37	35,048	
16	4,729.33	35,020	
17	4,729.28	34,985	
18	4,729.23	34,951	
19	4,729.19	34,923	
19.2	4,729.18	34,916	Joint
20	4,729.13	34,881	
21	4,729.07	34,840	
22	4,729.01	34,798	
23	4,728.95	34,756	
24	4,728.89	34,715	
25	4,728.83	34,673	
26	4,728.77	34,631	
27	4,728.71	34,590	
28	4,728.65	34,548	
29	4,728.59	34,506	
30	4,728.53	34,465	
31	4,728.47	34,423	
31.1	4,728.46	34,416	Saw cut
32	4,728.39	34,368	
33	4,728.32	34,319	
34	4,728.24	34,264	
35	4,728.17	34,215	
36	4,728.10	34,166	
37	4,728.02	34,111	
38	4,727.95	34,062	
39	4,727.87	34,007	
40	4,727.80	33,958	
41	4,727.73	33,910	
42	4,727.65	33,854	
43	4,727.58	33,806	
43.1	4,727.57	33,799	Joint
44	4,727.52	33,764	
44.35	4,727.76	33,930	Top ring #2
44.35	4,727.50	33,750	Base ring #2
45	4,727.44	33,708	
46	4,727.35	33,646	
47	4,727.26	33,583	
48	4,727.17	33,521	
49	4,727.07	33,452	
50	4,726.98	33,389	
51	4,726.89	33,327	
52	4,726.80	33,264	
53	4,726.71	33,220	
54	4,726.61	33,132	
55	4,726.52	33,070	
55.9	4,726.44	33,014	Saw cut
56	4,726.43	33,007	
57	4,726.34	32,945	
58	4,726.25	32,882	
59	4,726.16	32,820	
60	4,726.07	32,758	
61	4,725.98	32,695	
62	4,725.89	32,633	
63	4,725.80	32,570	
64	4,725.71	32,508	
65	4,725.62	32,445	
66	4,725.53	32,383	
66.3	4,725.50	32,362	Spillway crest
67	4,725.44	32,326	
68	4,725.35	32,271	
68.8	4,725.28	32,229	Joint
69	4,725.26	32,217	
70	4,725.16	32,156	
71	4,725.07	32,102	
72	4,724.97	32,041	
73	4,724.87	31,980	

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)

PAINTED ROCKS RESERVOIR - BOAT RAMP

DISTANCE feet	ELEVATION feet	STORAGE acre-feet	NOTES
74	4,724.78	31,926	
75	4,724.68	31,865	
76	4,724.58	31,804	
77	4,724.49	31,750	
78	4,724.39	31,689	
79	4,724.29	31,629	
80	4,724.20	31,574	
80.7	4,724.13	31,532	Saw cut
81	4,724.10	31,514	
82	4,724.00	31,453	
83	4,723.90	31,392	
84	4,723.80	31,332	
85	4,723.70	31,271	
86	4,723.60	31,211	
87	4,723.49	31,144	
88	4,723.39	31,083	
89	4,723.29	31,023	
90	4,723.19	30,962	
91	4,723.09	30,901	
92	4,722.99	30,840	
92.7	4,722.92	30,798	Joint
93	4,722.89	30,780	
94	4,722.78	30,713	
95	4,722.67	30,646	
96	4,722.56	30,579	
97	4,722.45	30,513	
98	4,722.34	30,446	
99	4,722.23	30,379	
100	4,722.12	30,313	
101	4,722.01	30,246	
102	4,721.90	30,179	
103	4,721.79	30,113	
104	4,721.68	30,046	
105	4,721.57	29,979	
105.6	4,721.50	29,937	Saw cut
106	4,721.46	29,913	
107	4,721.35	29,846	
108	4,721.24	29,779	
109	4,721.13	29,713	
110	4,721.02	29,646	
111	4,720.91	29,579	
112	4,720.81	29,513	
113	4,720.70	29,452	
114	4,720.59	29,386	
115	4,720.48	29,319	
116	4,720.37	29,252	
117	4,720.26	29,186	
118	4,720.15	29,119	
118.4	4,720.11	29,095	Joint
119	4,720.04	29,052	
120	4,719.93	28,986	
121	4,719.82	28,919	
122	4,719.71	28,852	
123	4,719.60	28,786	
124	4,719.49	28,719	
125	4,719.38	28,652	
126	4,719.27	28,586	
127	4,719.16	28,519	
128	4,719.05	28,452	
129	4,718.94	28,386	
130	4,718.83	28,319	
130.3	4,718.80	28,301	Joint
131	4,718.72	28,252	
132	4,718.60	28,180	
133	4,718.49	28,113	
134	4,718.37	28,040	
135	4,718.26	27,973	
136	4,718.14	27,900	
137	4,718.03	27,834	
138	4,717.91	27,761	
139	4,717.80	27,694	
140	4,717.68	27,621	
141	4,717.57	27,554	
142	4,717.45	27,482	
142.3	4,717.42	27,464	Joint
143	4,717.34	27,415	
144	4,717.22	27,342	
145	4,717.10	27,270	
146	4,716.99	27,203	
147	4,716.87	27,130	
148	4,716.75	27,058	
149	4,716.64	26,991	
150	4,716.52	26,918	
151	4,716.40	26,845	
152	4,716.29	26,779	
153	4,716.17	26,706	
154	4,716.05	26,633	
154.7	4,715.97	26,585	Saw cut
155	4,715.94	26,567	
156	4,715.82	26,494	
157	4,715.71	26,427	
158	4,715.60	26,361	
159	4,715.49	26,295	
160	4,715.38	26,237	

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)

PAINTED ROCKS RESERVOIR - BOAT RAMP

DISTANCE feet	ELEVATION feet	STORAGE acre-feet	NOTES
161	4,715.26	26,174	
162	4,715.15	26,117	
163	4,715.04	26,059	
164	4,714.93	26,001	
165	4,714.82	25,944	
166	4,714.70	25,881	
167	4,714.59	25,823	
167.2	4,714.57	25,813	Joint
168	4,714.48	25,766	
169	4,714.36	25,703	
170	4,714.24	25,640	
171	4,714.13	25,582	
172	4,714.01	25,519	
173	4,713.90	25,462	
174	4,713.78	25,399	
175	4,713.66	25,336	
176	4,713.55	25,278	
177	4,713.43	25,215	
178	4,713.32	25,158	
179	4,713.20	25,095	Saw cut
180	4,713.09	25,037	
181	4,712.97	24,974	
182	4,712.86	24,916	
183	4,712.74	24,853	
184	4,712.63	24,795	
185	4,712.52	24,738	
186	4,712.40	24,675	
187	4,712.29	24,617	
188	4,712.17	24,554	
189	4,712.06	24,496	
190	4,711.94	24,434	
191	4,711.83	24,376	Joint
192	4,711.72	24,318	
193	4,711.61	24,261	
194	4,711.51	24,208	
195	4,711.40	24,151	
196	4,711.29	24,093	
197	4,711.18	24,035	
198	4,711.07	23,978	
199	4,710.96	23,920	
200	4,710.86	23,868	
201	4,710.75	23,810	
202	4,710.64	23,752	
203	4,710.53	23,695	
203.2	4,710.51	23,684	Saw cut
204	4,710.42	23,637	
205	4,710.31	23,579	
206	4,710.19	23,517	
207	4,710.08	23,459	
208	4,709.97	23,401	
209	4,709.85	23,338	
210	4,709.74	23,281	
211	4,709.63	23,223	
212	4,709.51	23,160	
213	4,709.40	23,103	
214	4,709.29	23,045	
215	4,709.17	22,982	
215.2	4,709.15	22,972	Joint
216	4,709.06	22,924	
217	4,708.94	22,862	
218	4,708.82	22,799	
219	4,708.71	22,741	
220	4,708.59	22,678	
221	4,708.47	22,615	
222	4,708.36	22,558	
223	4,708.24	22,495	
224	4,708.12	22,432	
225	4,708.01	22,374	
226	4,707.89	22,311	
227	4,707.77	22,248	
227.1	4,707.76	22,243	Saw cut
228	4,707.66	22,190	
229	4,707.56	22,138	
230	4,707.45	22,080	
231	4,707.34	22,022	
232	4,707.23	21,965	
233	4,707.13	21,912	
234	4,707.02	21,854	
235	4,706.91	21,797	
236	4,706.80	21,739	
237	4,706.70	21,687	
238	4,706.59	21,629	
239	4,706.48	21,572	
239.1	4,706.47	21,566	Joint
240	4,706.37	21,514	
241	4,706.25	21,451	
242	4,706.14	21,393	
243	4,706.02	21,330	
244	4,705.91	21,273	
245	4,705.79	21,210	
246	4,705.68	21,152	
247	4,705.57	21,095	
248	4,705.45	21,035	
249	4,705.34	20,986	

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)

PAINTED ROCKS RESERVOIR - BOAT RAMP

DISTANCE feet	ELEVATION feet	STORAGE acre-feet	NOTES
250	4,705.22	20,932	
250.2	4,705.20	20,923	Saw cut
251	4,705.11	20,882	
252	4,705.01	20,837	
253	4,704.90	20,787	
254	4,704.79	20,738	
255	4,704.68	20,688	
256	4,704.57	20,639	
257	4,704.47	20,594	
258	4,704.36	20,544	
259	4,704.25	20,495	
260	4,704.14	20,445	
261	4,704.03	20,396	
261.6	4,703.97	20,369	Joint
262	4,703.93	20,351	
263	4,703.82	20,301	
264	4,703.71	20,252	
265	4,703.60	20,202	
266	4,703.49	20,152	
267	4,703.38	20,103	
268	4,703.27	20,053	
269	4,703.16	20,004	
270	4,703.06	19,959	
271	4,702.95	19,909	
272	4,702.84	19,859	
273	4,702.73	19,810	
274	4,702.62	19,760	Saw cut
275	4,702.51	19,711	
276	4,702.41	19,665	
277	4,702.30	19,636	
278	4,702.19	19,566	
279	4,702.08	19,517	
280	4,701.98	19,471	
281	4,701.87	19,422	
282	4,701.76	19,372	
283	4,701.65	19,323	
284	4,701.55	19,278	
285	4,701.44	19,228	
286	4,701.33	19,179	
286.4	4,701.29	19,161	Joint
287	4,701.22	19,129	
288	4,701.11	19,080	
289	4,701.00	19,030	
290	4,700.89	18,981	
291	4,700.77	18,927	
292	4,700.66	18,877	
293	4,700.55	18,828	
294	4,700.44	18,773	
295	4,700.32	18,724	
296	4,700.21	18,674	
297	4,700.10	18,625	
298	4,699.99	18,570	
298.4	4,699.94	18,552	Saw cut
299	4,699.88	18,525	
300	4,699.78	18,480	
301	4,699.68	18,435	
302	4,699.58	18,390	
303	4,699.48	18,345	
304	4,699.38	18,300	
305	4,699.27	18,250	
306	4,699.17	18,205	
307	4,699.07	18,160	
308	4,698.97	18,115	
309	4,698.87	18,070	
310	4,698.77	18,025	
310.6	4,698.71	17,998	Joint
311	4,698.67	17,980	
312	4,698.58	17,939	
313	4,698.49	17,898	
314	4,698.40	17,858	
315	4,698.30	17,813	
316	4,698.21	17,772	
317	4,698.12	17,732	
318	4,698.03	17,691	
319	4,697.93	17,646	
320	4,697.84	17,605	
321	4,697.75	17,565	
322	4,697.65	17,520	
322.7	4,697.59	17,493	Saw cut
323	4,697.57	17,484	
324	4,697.48	17,443	
325	4,697.40	17,407	
326	4,697.32	17,371	
327	4,697.24	17,335	
328	4,697.16	17,299	
329	4,697.08	17,263	
330	4,697.00	17,227	
331	4,696.92	17,191	
332	4,696.84	17,155	
333	4,696.76	17,119	
333.8	4,696.97	17,214	Top last ring
334	4,696.68	17,083	
334.45	4,696.64	17,065	End conc.

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE

PAINTED ROCKS RESERVOIR - BELOW BOAT RAMP

Pins installed and elevations established using a level in 1997.
The 0+00 pin located at the bottom left (upstream) corner of the concrete boat ramp slab.
Measurements begin at the ring at the bottom of the concrete boat ramp.
Active storage volumes from original 1938 hand surveys+ 656 acre-feet (Dead Storage) = Total Storage

DISTANCE feet	ELEVATION feet	STORAGE acre-feet	NOTES
0	4,696.97	17,214	Top last ring
0	4,696.64	17,065	End conc.
1	4,696.52	17,011	
2	4,696.39	16,952	
3	4,696.27	16,898	
4	4,696.14	16,840	
5	4,696.02	16,786	
6	4,695.90	16,731	
7	4,695.77	16,673	
8	4,695.65	16,619	
9	4,695.52	16,560	
10	4,695.40	16,513	
11	4,695.28	16,468	
12	4,695.15	16,418	
13	4,695.03	16,373	
14	4,694.90	16,324	
15	4,694.78	16,278	
16	4,694.66	16,233	
17	4,694.53	16,183	
18	4,694.41	16,138	
19	4,694.28	16,089	
20	4,694.16	16,043	
21	4,694.04	15,998	
22	4,693.91	15,948	
23	4,693.79	15,903	
24	4,693.66	15,854	
25	4,693.54	15,808	
26	4,693.46	15,778	
27	4,693.38	15,747	
28	4,693.30	15,717	
29	4,693.22	15,687	
30	4,693.14	15,656	
31	4,693.06	15,626	
32	4,692.97	15,592	
33	4,692.89	15,561	
34	4,692.81	15,531	
35	4,692.73	15,500	
36	4,692.65	15,470	
37	4,692.57	15,440	
38	4,692.49	15,409	
39	4,692.41	15,375	
40	4,692.33	15,349	
41	4,692.25	15,318	
42	4,692.17	15,288	
43	4,692.09	15,258	
44	4,692.00	15,224	
45	4,691.92	15,193	
46	4,691.84	15,163	
47	4,691.76	15,133	
48	4,691.68	15,102	
49	4,691.60	15,072	
50	4,691.67	15,098	Top pin #1
50	4,691.52	15,042	Top block #1
51	4,691.46	15,019	
52	4,691.40	14,996	
53	4,691.34	14,973	
54	4,691.28	14,951	
55	4,691.23	14,932	
56	4,691.17	14,909	
57	4,691.11	14,886	
58	4,691.05	14,863	
59	4,690.99	14,841	
60	4,690.93	14,818	
61	4,690.82	14,776	
62	4,690.71	14,735	
63	4,690.60	14,693	
64	4,690.49	14,651	
65	4,690.39	14,610	
66	4,690.28	14,572	
67	4,690.17	14,530	
68	4,690.06	14,488	
69	4,689.95	14,447	
70	4,689.84	14,405	
71	4,689.71	14,356	
72	4,689.57	14,303	
73	4,689.44	14,253	
74	4,689.30	14,200	
75	4,689.17	14,147	
76	4,689.03	14,098	
77	4,688.90	14,045	
78	4,688.76	13,996	
79	4,688.63	13,942	

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE (continued)

PAINTED ROCKS RESERVOIR - BELOW BOAT RAMP

DISTANCE feet	ELEVATION feet	STORAGE acre-feet	NOTES
80	4,688.49	13,893	
81	4,688.30	13,821	
82	4,688.11	13,749	
83	4,687.91	13,673	
84	4,687.72	13,601	
85	4,687.53	13,528	
86	4,687.25	13,422	
87	4,686.97	13,316	
88	4,686.70	13,214	
89	4,686.42	13,108	
90	4,686.14	13,002	
91	4,685.80	12,873	
92	4,685.45	12,743	
93	4,685.11	12,633	
94	4,684.76	12,519	
95	4,684.42	12,409	
96	4,684.19	12,334	
97	4,683.96	12,260	
98	4,683.72	12,182	
99	4,683.49	12,107	
100	4,683.38	12,071	Top pin #2
100	4,683.26	12,032	Top block #2
101	4,682.97	11,938	
102	4,682.68	11,844	
103	4,682.39	11,750	
104	4,682.09	11,653	
105	4,681.80	11,559	
106	4,681.51	11,465	
107	4,681.41	11,433	
108	4,681.30	11,397	
109	4,681.20	11,365	
110	4,681.09	11,329	
111	4,681.06	11,319	
112	4,681.03	11,310	
113	4,681.00	11,300	
114	4,680.97	11,290	
115	4,680.94	11,281	
116	4,680.90	11,268	
117	4,680.87	11,258	
118	4,680.84	11,248	
119	4,680.81	11,238	
120	4,680.78	11,229	
121	4,680.65	11,187	
122	4,680.53	11,148	
123	4,680.40	11,106	
124	4,680.28	11,067	
125	4,680.15	11,024	
126	4,680.02	10,982	
127	4,679.90	10,943	
128	4,679.77	10,901	
129	4,679.65	10,862	
130	4,679.52	10,820	
131	4,679.39	10,777	
132	4,679.26	10,735	
133	4,679.14	10,696	
134	4,679.01	10,654	
135	4,678.88	10,612	
136	4,678.75	10,570	
137	4,678.62	10,528	
138	4,678.50	10,489	
139	4,678.37	10,447	
140	4,678.24	10,405	
141	4,678.13	10,369	
142	4,678.02	10,333	
143	4,677.91	10,298	
144	4,677.80	10,262	
145	4,677.69	10,227	
146	4,677.58	10,191	
147	4,677.47	10,155	
148	4,677.36	10,120	
149	4,677.25	10,084	
150	4,677.27	10,090	Top pin #3
150	4,677.14	10,048	Top block #3
151	4,676.99	9,999	
152	4,676.84	9,951	
153	4,676.68	9,899	
154	4,676.53	9,850	
155	4,676.38	9,801	
156	4,676.23	9,753	
157	4,676.08	9,704	
158	4,675.92	9,652	
159	4,675.77	9,603	
160	4,675.62	9,555	
161	4,675.58	9,542	
162	4,675.54	9,529	
163	4,675.50	9,516	
164	4,675.46	9,505	
165	4,675.42	9,494	
166	4,675.38	9,483	
167	4,675.34	9,473	
168	4,675.30	9,462	
169	4,675.26	9,451	

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE (continued)

PAINTED ROCKS RESERVOIR - BELOW BOAT RAMP

DISTANCE feet	ELEVATION feet	STORAGE acre-feet	NOTES	DISTANCE feet	ELEVATION feet	STORAGE acre-feet	NOTES
170	4,675.22	9,440		215	4,668.22	7,544	
171	4,675.11	9,410		216	4,668.10	7,512	
172	4,674.99	9,378		217	4,667.99	7,482	
173	4,674.88	9,348		218	4,667.87	7,450	
174	4,674.77	9,318		219	4,667.76	7,420	
175	4,674.66	9,286		220	4,667.64	7,388	
176	4,674.54	9,256		221	4,667.60	7,377	
177	4,674.43	9,226		222	4,667.55	7,364	
178	4,674.32	9,196		223	4,667.51	7,350	
179	4,674.20	9,164		224	4,667.47	7,342	
180	4,674.09	9,134		225	4,667.43	7,331	
181	4,673.94	9,093		226	4,667.38	7,317	
182	4,673.79	9,053		227	4,667.34	7,307	
183	4,673.64	9,012		228	4,667.30	7,296	
184	4,673.49	8,971		229	4,667.25	7,282	
185	4,673.35	8,931		230	4,667.21	7,271	
186	4,673.20	8,893		231	4,667.21	7,271	
187	4,673.05	8,852		232	4,667.20	7,269	
188	4,672.90	8,812		233	4,667.20	7,269	
189	4,672.75	8,771		234	4,667.19	7,266	
190	4,672.60	8,731		235	4,667.19	7,266	
191	4,672.41	8,680		236	4,667.19	7,266	
192	4,672.23	8,631		237	4,667.18	7,263	
193	4,672.04	8,579		238	4,667.18	7,263	
194	4,671.86	8,531		239	4,667.17	7,261	
195	4,671.67	8,479		240	4,667.17	7,261	
196	4,671.48	8,428		241	4,667.14	7,252	
197	4,671.30	8,379		242	4,667.12	7,247	
198	4,671.11	8,327		243	4,667.09	7,239	
199	4,670.93	8,279		244	4,667.07	7,233	
200	4,670.81	8,246	Top pin #4	245	4,667.04	7,225	
200	4,670.72	8,222	Top block #4	246	4,667.01	7,215	
201	4,670.53	8,170		247	4,666.99	7,212	
202	4,670.34	8,119		248	4,666.96	7,204	
203	4,670.14	8,064		249	4,666.94	7,198	
204	4,669.95	8,013		250	4,666.91	7,190	
205	4,669.76	7,961		251	4,666.88	7,182	
206	4,669.57	7,910		252	4,666.85	7,174	
207	4,669.38	7,858		253	4,666.82	7,166	
208	4,669.18	7,804		254	4,666.79	7,158	
209	4,668.99	7,753		255	4,666.76	7,149	
210	4,668.80	7,701		256	4,666.73	7,141	
211	4,668.68	7,669		257	4,666.70	7,133	
212	4,668.57	7,639		258	4,666.67	7,125	
213	4,668.45	7,606		259	4,666.64	7,117	
214	4,668.34	7,577		260	4,666.61	7,109	

TABLE 2. SLOPE-ELEVATION-STORAGE TABLE (continued)

PAINTED ROCKS RESERVOIR - BELOW BOAT RAMP

DISTANCE feet	ELEVATION feet	STORAGE acre-feet	NOTES
261	4,666.65	7,120	
262	4,666.68	7,128	
263	4,666.72	7,139	
264	4,666.75	7,147	
265	4,666.79	7,155	
266	4,666.82	7,166	
267	4,666.86	7,174	
268	4,666.89	7,185	
269	4,666.93	7,193	
270	4,666.96	7,204	
271	4,666.95	7,201	
272	4,666.95	7,201	
273	4,666.94	7,198	
274	4,666.94	7,198	
275	4,666.93	7,196	
276	4,666.92	7,193	
277	4,666.92	7,193	
278	4,666.91	7,190	
279	4,666.91	7,190	
280	4,666.90	7,187	
281	4,666.89	7,185	
282	4,666.88	7,182	
283	4,666.86	7,177	
284	4,666.85	7,174	
285	4,666.84	7,171	
286	4,666.83	7,168	
287	4,666.82	7,166	
288	4,666.80	7,160	
289	4,666.79	7,158	
290	4,666.78	7,155	
291	4,666.77	7,152	
292	4,666.77	7,152	
293	4,666.76	7,149	
294	4,666.75	7,147	
295	4,666.75	7,147	
296	4,666.74	7,144	
297	4,666.73	7,141	
298	4,666.72	7,139	
299	4,666.72	7,139	
300	4,666.71	7,136	
301	4,666.72	7,139	
302	4,666.72	7,139	
303	4,666.73	7,141	
304	4,666.74	7,144	
305	4,666.75	7,144	
306	4,666.75	7,147	
307	4,666.76	7,149	
308	4,666.77	7,152	
309	4,666.77	7,152	
310	4,666.78	7,155	
311	4,666.78	7,155	
312	4,666.78	7,155	
313	4,666.77	7,152	
314	4,666.77	7,152	
315	4,666.77	7,152	
316	4,666.77	7,152	
317	4,666.77	7,152	
318	4,666.76	7,149	
319	4,666.76	7,149	
320	4,666.76	7,149	
321	4,666.69	7,130	
322	4,666.63	7,114	
323	4,666.56	7,095	
324	4,666.49	7,076	
325	4,666.43	7,060	
326	4,666.36	7,041	
327	4,666.29	7,022	
328	4,666.22	7,003	
329	4,666.16	6,987	
330	4,666.09	6,968	
331	4,665.95	6,930	
332	4,665.81	6,892	
333	4,665.67	6,854	
334	4,665.54	6,819	
335	4,665.40	6,786	
336	4,665.26	6,754	
337	4,665.12	6,723	
338	4,664.98	6,691	
339	4,664.84	6,660	
340	4,664.71	6,630	
341	4,664.57	6,599	
342	4,664.43	6,567	
343	4,664.29	6,536	

TABLE 3. TOTAL STORAGE IN ACRE-FEET

PAINTED ROCKS DAM

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
4625						656	665	673	682	691
4626	699	708	716	725	734	743	751	760	769	777
4627	786	795	803	812	821	830	838	847	856	864
4628	873	882	890	899	908	917	925	934	943	951
4629	960	969	977	986	995	1004	1012	1021	1030	1038
4630	1047	1056	1064	1073	1081	1090	1099	1107	1116	1124
4631	1133	1142	1150	1159	1168	1177	1185	1194	1203	1211
4632	1220	1228	1237	1245	1254	1263	1272	1280	1289	1298
4633	1307	1316	1324	1333	1341	1350	1359	1367	1376	1384
4634	1393	1402	1410	1419	1427	1436	1444	1453	1462	1471
4635	1480	1488	1497	1506	1514	1523	1536	1549	1562	1575
4636	1588	1601	1614	1627	1640	1653	1666	1679	1692	1705
4637	1718	1731	1744	1757	1770	1783	1796	1809	1822	1835
4638	1848	1861	1874	1887	1900	1913	1926	1939	1952	1965
4639	1978	1991	2004	2017	2030	2043	2056	2069	2082	2095
4640	2108	2121	2134	2147	2160	2173	2186	2199	2212	2225
4641	2238	2251	2264	2277	2290	2303	2316	2329	2342	2355
4642	2368	2381	2394	2407	2420	2433	2446	2459	2472	2485
4643	2498	2511	2524	2537	2550	2563	2576	2589	2602	2615
4644	2628	2641	2654	2667	2680	2693	2706	2719	2732	2745
4645	2758	2771	2784	2797	2810	2823	2840	2858	2875	2892
4646	2910	2927	2945	2962	2979	2997	3014	3031	3048	3066
4647	3083	3100	3118	3135	3153	3170	3187	3205	3222	3240
4648	3257	3274	3292	3309	3326	3344	3361	3378	3395	3413
4649	3430	3447	3465	3482	3500	3517	3534	3552	3569	3587
4650	3604	3621	3639	3656	3673	3691	3708	3725	3742	3760
4651	3777	3794	3812	3829	3846	3864	3881	3898	3915	3933
4652	3950	3967	3985	4002	4020	4037	4054	4072	4089	4107
4653	4124	4141	4159	4176	4193	4211	4228	4245	4262	4280
4654	4297	4314	4332	4349	4367	4384	4401	4419	4436	4454
4655	4471	4488	4505	4522	4540	4557	4580	4602	4625	4647
4656	4670	4692	4715	4737	4760	4782	4805	4827	4850	4872
4657	4895	4917	4940	4962	4985	5007	5030	5052	5075	5097
4658	5120	5143	5165	5188	5210	5233	5255	5278	5300	5323
4659	5345	5368	5390	5413	5435	5458	5480	5503	5525	5548
4660	5570	5593	5615	5638	5660	5683	5706	5728	5751	5773
4661	5796	5819	5841	5864	5886	5909	5931	5954	5976	5999
4662	6021	6043	6066	6088	6111	6133	6156	6178	6201	6223
4663	6246	6269	6291	6314	6336	6359	6381	6404	6426	6449
4664	6471	6493	6516	6538	6561	6583	6606	6628	6651	6673
4665	6696	6718	6741	6763	6786	6808	6835	6862	6889	6916
4666	6944	6971	6998	7025	7052	7080	7107	7134	7161	7188
4667	7215	7242	7269	7296	7323	7350	7377	7404	7431	7458
4668	7485	7512	7539	7566	7593	7621	7648	7674	7701	7728
4669	7756	7783	7810	7837	7864	7892	7919	7946	7973	8000
4670	8027	8054	8081	8108	8135	8163	8189	8216	8243	8270

TABLE 3. TOTAL STORAGE IN ACRE-FEET (continued)

PAINTED ROCKS DAM

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
4671	8298	8325	8352	8379	8406	8433	8460	8487	8514	8541
4672	8569	8596	8623	8650	8677	8704	8731	8758	8785	8812
4673	8839	8866	8893	8920	8947	8974	9001	9028	9055	9082
4674	9109	9136	9163	9190	9217	9244	9272	9299	9326	9353
4675	9380	9408	9435	9462	9489	9516	9548	9581	9613	9646
4676	9678	9710	9743	9775	9808	9840	9873	9905	9938	9970
4677	10003	10035	10068	10100	10133	10165	10197	10230	10262	10295
4678	10327	10359	10392	10424	10457	10489	10521	10554	10586	10619
4679	10651	10684	10716	10749	10781	10814	10846	10879	10911	10944
4680	10976	11008	11041	11073	11106	11138	11170	11203	11235	11268
4681	11300	11332	11365	11397	11430	11462	11494	11527	11559	11592
4682	11624	11656	11689	11721	11754	11786	11818	11851	11883	11916
4683	11948	11981	12013	12046	12078	12111	12143	12176	12208	12241
4684	12273	12305	12338	12370	12403	12435	12467	12500	12532	12565
4685	12597	12629	12662	12694	12727	12759	12797	12835	12873	12911
4686	12949	12987	13025	13063	13101	13139	13176	13214	13252	13290
4687	13328	13366	13404	13442	13480	13518	13555	13593	13631	13669
4688	13707	13745	13783	13821	13859	13897	13935	13973	14011	14049
4689	14087	14125	14163	14201	14239	14277	14314	14352	14390	14428
4690	14466	14504	14542	14580	14618	14656	14693	14731	14769	14807
4691	14845	14883	14921	14959	14997	15035	15072	15110	15148	15186
4692	15224	15262	15300	15338	15376	15414	15451	15489	15527	15565
4693	15603	15641	15679	15717	15755	15793	15831	15869	15907	15945
4694	15983	16021	16059	16097	16135	16173	16210	16248	16286	16324
4695	16362	16399	16437	16475	16513	16551	16596	16641	16686	16731
4696	16777	16822	16867	16912	16957	17002	17047	17092	17137	17182
4697	17227	17272	17317	17362	17407	17452	17497	17542	17587	17632
4698	17677	17722	17767	17812	17857	17902	17948	17993	18038	18083
4699	18128	18173	18218	18263	18308	18353	18399	18444	18489	18534
4700	18579	18624	18669	18714	18759	18804	18850	18895	18940	18985
4701	19030	19075	19120	19165	19210	19255	19300	19345	19390	19435
4702	19480	19525	19570	19615	19660	19705	19751	19796	19841	19886
4703	19931	19976	20021	20066	20111	20156	20202	20247	20292	20337
4704	20382	20427	20472	20517	20562	20607	20652	20697	20742	20787
4705	20832	20878	20923	20968	21013	21058	21110	21163	21215	21268
4706	21320	21372	21425	21477	21530	21582	21634	21687	21739	21792
4707	21844	21896	21949	22001	22054	22106	22158	22211	22263	22316
4708	22369	22421	22474	22526	22579	22631	22683	22736	22788	22841
4709	22893	22945	22998	23050	23103	23155	23207	23260	23312	23365
4710	23417	23469	23522	23574	23627	23679	23731	23784	23836	23889
4711	23941	23993	24046	24098	24151	24203	24255	24308	24360	24413
4712	24465	24517	24570	24622	24675	24727	24779	24832	24884	24937
4713	24990	25042	25095	25147	25200	25252	25304	25357	25409	25462
4714	25514	25566	25619	25671	25724	25776	25828	25881	25933	25986
4715	26038	26091	26143	26195	26248	26300	26361	26421	26482	26543

TABLE 3. TOTAL STORAGE IN ACRE-FEET (continued)

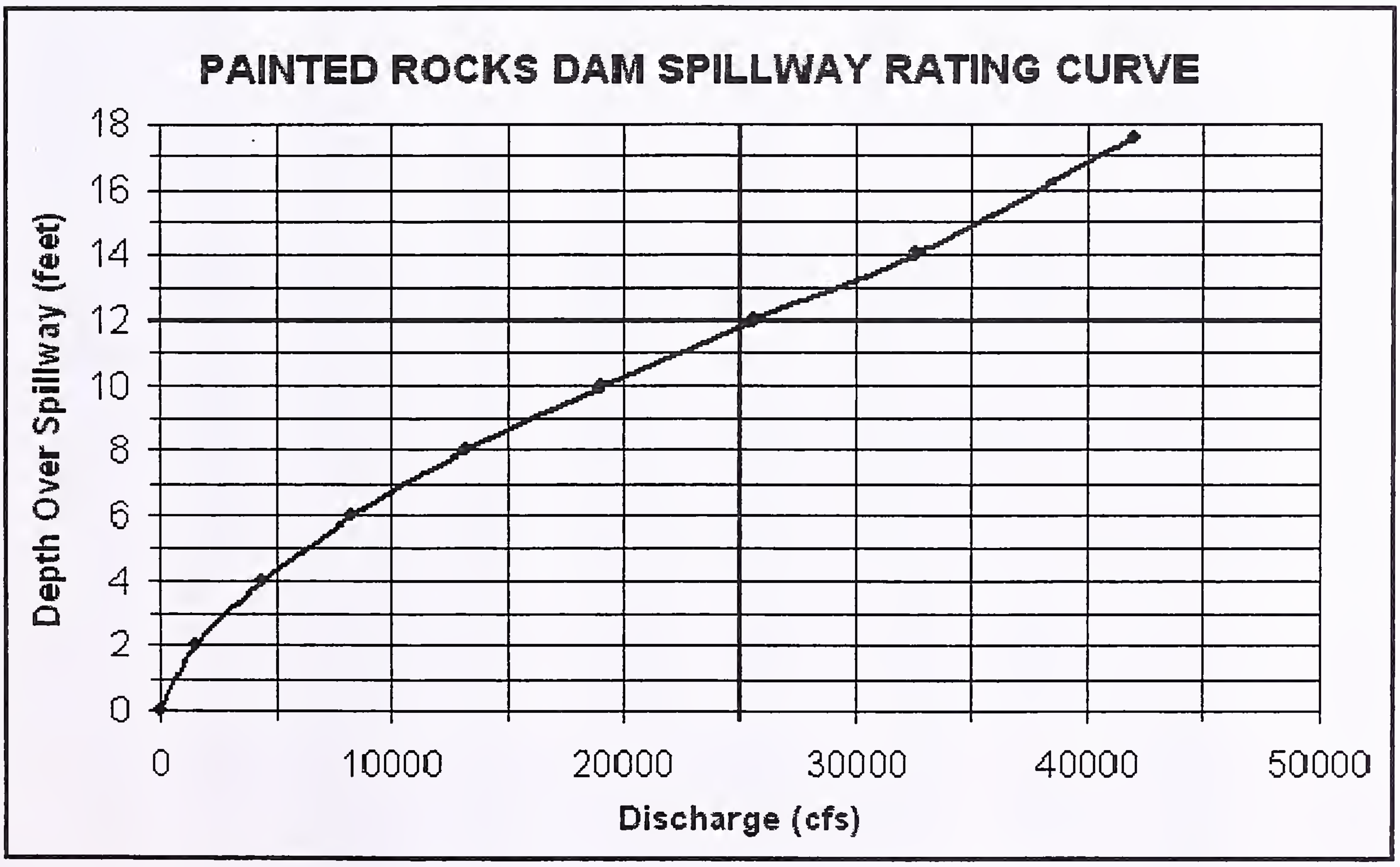
PAINTED ROCKS DAM

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
4716	26603	26664	26724	26785	26845	26906	26967	27027	27088	27148
4717	27209	27270	27330	27391	27451	27512	27573	27633	27694	27754
4718	27815	27876	27936	27997	28057	28118	28179	28239	28300	28360
4719	28422	28483	28543	28604	28664	28725	28786	28846	28907	28967
4720	29028	29089	29149	29210	29270	29331	29392	29452	29513	29573
4721	29634	29695	29755	29816	29876	29937	29937	29937	29937	29937
4722	30240	30301	30361	30422	30482	30543	30604	30664	30725	30785
4723	30846	30907	30967	31028	31089	31150	31210	31271	31332	31392
4724	31453	31514	31574	31635	31696	31757	31817	31878	31939	31999
4725	32059	32120	32180	32241	32301	32362	32431	32501	32570	32640
4726	32709	32778	32848	32917	32987	33056	33125	33195	33264	33334
4727	33403	33472	33542	33611	33681	33750	33819	33889	33958	34028
4728	34097	34166	34236	34305	34375	34444	34513	34583	34652	34722
4729	34791	34860	34930	34999	35069	35138	35207	35277	35346	35416
4730	35485	35554	35624	35693	35763	35832				

TABLE 4. SPILLWAY DISCHARGE

PAINTED ROCKS DAM

Depth Over Crest (feet)	Elevation (feet)	Discharge (cfs)	Comments
0.0	4725.5	0	Spillway Crest
2.0	4727.5	1460	
4.0	4729.5	4320	
6.0	4731.5	8270	
8.0	4733.5	13220	
10.0	4735.5	19120	
12.0	4737.5	25640	
14.0	4739.5	32640	
17.6	4743.07	42000	Dam Crest



Note: Data from the Corps of Engineers Phase 1 Inspection Report (1980).

TABLE 5. WEST FORK BITTERROOT RIVER RATING TABLE
(USGS Gage 12342500 -- West Fork Bitterroot Near Connor, MT)
(Gage Located On Right Bank 0.6 Miles Below Reservoir)

GAGE HEIGHT (Feet)	DISCHARGE (Cubic Feet Per Second)									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.5	7.50	7.83	8.18	8.54	8.90	9.28	9.67	10.70	10.48	10.99
0.6	11.34	11.79	12.25	12.72	13.21	13.71	14.22	14.75	15.29	15.85
0.7	16.41	17.00	17.60	18.21	18.81	19.48	20.14	20.81	21.50	22.21
0.8	22.94	23.68	24.43	35.21	26.00	26.81	27.61	28.68	29.34	30.23
0.9	31.13	32.05	32.99	33.95	34.92	35.92	36.94	37.96	19.84	40.12
1.0	41.23	42.35	43.49	44.66	45.85	47.05	48.30	49.56	50.84	52.14
1.1	53.47	54.83	56.28	57.60	59.03	60.48	61.96	63.46	64.99	66.54
1.2	68.12	69.73	71.37	73.03	74.72	76.43	78.18	79.95	81.75	83.58
1.3	85.44	87.33	89.25	91.20	93.18	85.19	97.23	99.00	101.40	103.50
1.4	105.70	107.90	110.10	112.40	114.70	117.00	119.40	121.80	124.20	126.70
1.5	129.20	131.70	134.30	136.90	135.60	142.20	144.90	147.70	150.50	153.30
1.6	156.20	159.10	162.00	165.00	168.00	171.10	147.20	177.30	180.50	183.70
1.7	187.00	190.40	193.80	197.30	200.80	204.30	207.50	211.40	215.00	218.60
1.8	222.20	225.90	229.60	233.30	237.10	240.90	244.70	248.50	252.40	256.30
1.9	260.20	264.10	268.10	272.10	276.10	280.10	284.20	288.30	292.40	296.60
2.0	300.80	605.00	309.20	313.80	317.70	322.00	326.40	330.70	335.10	339.50
2.1	344.00	348.40	352.90	357.80	362.00	366.50	371.10	375.70	380.40	385.40
2.2	389.70	394.50	399.20	404.00	408.80	413.60	418.40	423.30	428.20	433.10
2.3	338.10	343.00	448.00	453.20	458.10	463.70	468.30	473.40	478.50	483.70
2.4	288.30	494.10	499.40	506.70	509.90	515.30	520.60	526.00	531.40	536.80
2.5	542.20	547.70	553.20	558.70	564.30	569.80	575.10	581.00	586.70	592.30
2.6	598.00	603.70	609.50	615.20	621.00	626.80	632.70	638.50	644.40	650.30
2.7	656.20	662.20	668.20	674.20	680.20	686.30	692.30	698.40	704.60	710.70
2.8	716.90	723.10	729.30	735.50	741.80	748.10	754.40	760.70	767.10	773.50
2.9	779.90	786.30	792.80	799.30	805.80	812.30	818.90	825.40	832.00	838.60
3.0	845.30	852.00	858.60	865.40	872.10	878.90	885.60	892.50	899.30	906.10
3.1	913.00	919.90	926.90	933.80	940.00	947.80	954.80	961.80	964.90	976.00
3.2	983.10	990.20	997.40	1005.00	1012.00	1019.00	1026.00	1036.00	1041.00	1048.00
3.3	1055.00	1063.00	1070.00	1078.00	1085.00	1093.00	1100.00	1107.00	1115.00	1123.00
3.4	1130.00	1138.00	1145.00	1153.00	1161.00	1168.00	1176.00	1184.00	1192.00	1199.00
3.5	1207.00	1215.00	1223.00	1231.00	1238.00	1246.00	1254.00	1262.00	1270.00	1278.00
3.6	1286.00	1294.00	1302.00	1310.00	1319.00	1327.00	1335.00	1343.00	1351.00	1360.00
3.7	1368.00	1376.00	1384.00	1393.00	1401.00	1409.00	1418.00	1426.00	1435.00	1443.00
3.8	1451.00	1460.00	1468.00	1477.00	1486.00	1494.00	1503.00	1511.00	1520.00	1529.00
3.9	1537.00	1546.00	1555.00	1564.00	1572.00	1581.00	1590.00	1599.00	1608.00	1617.00
4.0	1625.00	1634.00	1643.00	1652.00	1661.00	1670.00	1679.00	1688.00	1698.00	1707.00
4.1	1716.00	1725.00	1734.00	1743.00	1753.00	1762.00	1771.00	1780.00	1790.00	1799.00
4.2	1808.00	1818.00	1827.00	1836.00	1846.00	1855.00	1865.00	1874.00	1884.00	1893.00
4.3	1903.00	1912.00	1922.00	1932.00	1941.00	1951.00	1961.00	1970.00	1980.00	1990.00
4.4	2000.00	2018.00	2019.00	2029.00	2039.00	2049.00	2059.00	2069.00	2078.00	2089.00
4.5	2099.00	2109.00	2119.00	2129.00	2139.00	2149.00	2159.00	2169.00	2179.00	2190.00
4.6	2200.00	2210.00	2220.00	2231.00	2241.00	2251.00	2261.00	2272.00	2282.00	2293.00
4.7	2303.00	2313.00	2324.00	2334.00	2345.00	2355.00	2366.00	2377.00	2387.00	2398.00
4.8	2408.00	2419.00	2430.00	2440.00	2451.00	2462.00	2743.00	2483.00	2494.00	2505.00
4.9	2516.00	2527.00	2538.00	2548.00	2559.00	2570.00	2581.00	2592.00	2603.00	2614.00
5.0	2625.00	2636.00	2647.00	2658.00	2670.00	2681.00	2692.00	2703.00	2714.00	2726.00
5.1	2737.00	2748.00	2760.00	2771.00	2782.00	2794.00	2805.00	2816.00	2828.00	2839.00
5.0	2851.00	2862.00	2874.00	2885.00	2897.00	2908.00	2920.00	2931.00	2943.00	2955.00
5.3	2966.00	2978.00	2990.00	3002.00	3013.00	3025.00	3037.00	3049.00	3061.00	3072.00
5.4	3084.00	3096.00	3108.00	3120.00	3132.00	3144.00	3156.00	3168.00	3180.00	3192.00
5.5	3204.00	3216.00	3228.00	3240.00	3253.00	3265.00	3277.00	3289.00	3301.00	3314.00
5.6	3326.00	3338.00	3351.00	3363.00	3375.00	3388.00	3400.00	3413.00	3425.00	3438.00
5.7	3450.00									

Table created 6/15/2001 by U.S. Department Of Interior, Geological Survey, Water Resources Division.
Rating Table No. 7.0 (Current as of 1/3/2007)

TABLE 6. WEST FORK BITTERROOT RIVER RATING TABLE

(Gage Located Above Reservoir at Coal Creek Bridge)

GAGE HEIGHT (feet)	DISCHARGE (Cubic Feet Per Second)									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.00	0.00	0.01	0.01	0.03	0.05	0.07	0.10	0.14	0.19
0.1	0.24	0.30	0.36	0.43	0.51	0.60	0.70	0.80	0.92	1.04
0.2	1.17	1.31	1.46	1.61	1.78	1.96	2.14	2.33	2.54	2.75
0.3	2.98	3.21	3.45	3.70	3.97	4.24	4.53	4.82	5.13	5.44
0.4	5.77	6.11	6.45	6.81	7.18	7.57	7.96	8.36	8.78	9.20
0.5	9.64	10.09	10.55	11.03	11.51	12.01	12.52	13.04	13.57	14.12
0.6	14.67	15.24	15.82	16.42	17.02	17.64	18.27	18.92	19.57	20.24
0.7	20.92	21.62	22.32	23.04	23.78	24.52	25.28	26.05	26.84	27.64
0.8	28.45	29.28	30.12	30.97	31.83	32.71	33.61	34.51	35.43	36.37
0.9	37.31	38.27	39.25	40.24	41.24	42.26	43.29	44.33	45.39	46.47
1.0	47.55	48.66	49.77	50.90	52.05	53.21	54.38	55.57	56.77	57.99
1.1	59.22	60.47	61.73	63.01	64.30	65.60	66.92	68.26	69.61	70.98
1.2	72.36	73.75	75.16	76.59	78.03	79.49	80.96	82.44	83.95	85.46
1.3	87.00	88.54	90.11	91.69	93.28	94.89	96.52	98.16	99.82	101.49
1.4	103.18	104.88	106.60	108.34	110.09	111.86	113.64	115.44	117.26	119.09
1.5	120.94	122.80	124.68	126.58	128.49	130.42	132.37	134.33	136.31	138.30
1.6	140.31	142.34	144.38	146.44	148.52	150.61	152.72	154.85	156.99	159.15
1.7	161.33	163.52	165.73	167.95	170.20	172.46	174.73	177.03	179.34	181.67
1.8	184.01	186.37	188.75	191.15	193.56	195.99	198.44	200.90	203.39	205.89
1.9	208.40	210.94	213.49	216.06	218.64	221.24	223.86	226.50	229.16	231.83
2.0	234.52	237.23	239.96	242.70	245.46	248.24	251.04	253.85	256.68	259.53
2.1	262.40	265.28	268.19	271.11	274.05	277.01	279.98	282.97	285.98	289.01
2.2	292.06	295.13	298.21	301.31	304.43	307.57	310.72	313.90	317.09	320.30
2.3	323.53	326.78	330.04	333.33	336.63	339.95	343.29	346.65	350.02	353.42
2.4	356.83	360.26	363.71	367.18	370.67	374.18	377.70	381.25	384.81	388.39
2.5	391.99	395.61	399.25	402.90	406.58	410.27	413.99	417.72	421.47	425.24
2.6	429.03	432.84	436.67	440.51	444.38	448.26	452.17	456.09	460.03	463.99
2.7	467.97	471.97	475.99	480.03	484.09	488.16	492.26	496.37	500.51	504.66
2.8	508.84	513.03	517.24	521.48	525.73	530.00	534.29	538.60	542.93	547.28
2.9	551.65	556.04	560.45	564.87	569.32	573.79	578.28	582.78	587.31	591.86
3.0	596.43	601.01	605.62	610.25	614.89	619.56	624.24	628.95	633.68	638.42
3.1	643.19	647.98	652.78	657.61	662.46	667.32	672.21	677.12	682.04	686.99
3.2	691.96	696.95	701.95	706.98	712.03	717.10	722.19	727.30	732.43	737.58
3.3	742.75	747.95	753.16	758.39	763.64	768.92	774.21	779.53	784.86	790.22
3.4	795.59	800.99	806.41	811.85	817.31	822.78	828.29	833.81	839.35	844.91

Table created 1/7/2005 by Ron Roman, Montana DNRC -- Water Resources Division.
Rating Table No. 4

The regression equation of log discharge on log gage height is: LOG Q = 2.30 x LOG (Gage Height) + 1.68
This equation has an r-squared value of 0.9982

The arithmetic form of this equation is: $Q = 47.55 \times (\text{GAGE HEIGHT})^{2.30}$

TABLE 7. BLUE JOINT CREEK RATING TABLE

GAGE HEIGHT (feet)	DISCHARGE (Cubic Feet Per Second)									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.00	0.17	0.44	0.76	1.12	1.52	1.94	2.38	2.85	3.34
0.1	3.85	4.38	4.92	5.48	6.05	6.64	7.25	7.86	8.49	9.13
0.2	9.78	10.44	11.12	11.80	12.50	13.20	13.92	14.64	15.38	16.12
0.3	16.87	17.63	18.40	19.18	19.96	20.76	21.56	22.37	23.18	24.01
0.4	24.84	25.67	26.52	27.37	28.23	29.10	29.97	30.85	31.74	32.63
0.5	33.53	34.43	35.34	36.26	37.18	38.11	39.04	39.98	40.93	41.88
0.6	42.84	43.80	44.77	45.74	46.72	47.71	48.70	49.69	50.69	51.69
0.7	52.70	53.72	54.74	55.76	56.79	57.83	58.87	59.91	60.96	62.01
0.8	63.07	64.13	65.20	66.27	67.34	68.42	69.51	70.60	71.69	72.79
0.9	73.89	75.00	76.11	77.22	78.34	79.46	80.59	81.72	82.85	83.99
1.0	85.13	86.28	87.43	88.59	89.74	90.91	92.07	93.24	94.42	95.59
1.1	96.77	97.96	99.15	100.34	101.53	102.73	103.94	105.14	106.35	107.57
1.2	108.78	110.00	111.23	112.46	113.69	114.92	116.16	117.40	118.64	119.89
1.3	121.14	122.40	123.66	124.92	126.18	127.45	128.72	129.99	131.27	132.55
1.4	133.84	135.12	136.41	137.71	139.00	140.30	141.60	142.91	144.22	145.53
1.5	146.84	148.16	149.48	150.81	152.13	153.46	154.79	156.13	157.47	158.81
1.6	160.15	161.50	162.85	164.20	165.56	166.92	168.28	169.65	171.01	172.38
1.7	173.75	175.13	176.51	177.89	179.27	180.66	182.05	183.44	184.84	186.23
1.8	187.63	189.04	190.44	191.85	193.26	194.67	196.09	197.51	198.93	200.35
1.9	201.78	203.21	204.64	206.08	207.51	208.95	210.39	211.84	213.29	214.74
2.0	216.19	217.64	219.10	220.56	222.02	223.49	224.95	226.42	227.89	229.37
2.1	230.84	232.32	233.80	235.29	236.78	238.26	239.76	241.25	242.74	244.24
2.2	245.74	247.25	248.75	250.26	251.77	253.28	254.80	256.31	257.83	259.35
2.3	260.88	262.40	263.93	265.46	267.00	268.53	270.07	271.61	273.15	274.69
2.4	276.24	277.79	279.34	280.89	282.45	284.01	285.56	287.13	288.69	290.26
2.5	291.83	293.40	294.97	296.54	298.12	299.70	301.28	302.86	304.45	306.04
2.6	307.63	309.22	310.81	312.41	314.01	315.61	317.21	318.81	320.42	322.03
2.7	323.64	325.25	326.87	328.48	330.10	331.72	333.34	334.97	336.60	338.22
2.8	339.86	341.49	343.12	344.76	346.40	348.04	349.68	351.33	352.97	354.62
2.9	356.27	357.93	359.58	361.24	362.90	364.56	366.22	367.88	369.55	371.22
3.0	372.89	374.56	376.23	377.91	379.59	381.27	382.95	384.63	386.32	388.01
3.1	389.69	391.39	393.08	394.77	396.47	398.17	399.87	401.57	403.28	404.98
3.2	406.69	408.40	410.11	411.82	413.54	415.26	416.97	418.69	420.42	422.14
3.3	423.87	425.59	427.32	429.06	430.79	432.52	434.26	436.00	437.74	439.48
3.4	441.23	442.97	444.72	446.47	448.22	449.97	451.73	453.48	455.24	457.00

Table created 1/7/2005 by Ron Roman, Montana DNRC -- Water Resources Division.
Rating Table No. 4

The regression equation of log discharge on log gage height is: $\text{LOG } Q = 1.34 \times \text{LOG (Gage Height)} + 1.93$
This equation has an r-squared value of 0.9976

The arithmetic form of this equation is: $Q = 85.13\text{x (GAGE HEIGHT)}^{1.34}$

TABLE 8. OVERWICH CREEK RATING TABLE

GAGE HEIGHT (feet)	DISCHARGE (Cubic Feet Per Second)									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03
0.1	0.04	0.05	0.06	0.08	0.10	0.12	0.15	0.18	0.21	0.25
0.2	0.29	0.34	0.39	0.44	0.50	0.56	0.63	0.71	0.79	0.87
0.3	0.96	1.06	1.17	1.28	1.39	1.52	1.65	1.79	1.94	2.09
0.4	2.25	2.42	2.60	2.79	2.99	3.19	3.41	3.63	3.86	4.10
0.5	4.36	4.62	4.89	5.17	5.47	5.77	6.09	6.41	6.75	7.10
0.6	7.46	7.83	8.22	8.62	9.03	9.45	9.88	10.33	10.80	11.27
0.7	11.76	12.26	12.78	13.31	13.86	14.42	14.99	15.58	16.19	16.81
0.8	17.44	18.09	18.76	19.44	20.14	20.86	21.59	22.34	23.11	23.89
0.9	24.70	25.51	26.35	27.21	28.08	28.97	29.88	30.81	31.75	32.72
1.0	33.71	34.71	35.73	36.78	37.84	38.93	40.03	41.16	42.30	43.47
1.1	44.66	45.87	47.10	48.35	49.62	50.92	52.24	53.58	54.94	56.33
1.2	57.74	59.17	60.62	62.10	63.60	65.13	66.68	68.26	69.85	71.48
1.3	73.13	74.80	76.50	78.22	79.97	81.74	83.55	85.37	87.22	89.10
1.4	91.01	92.94	94.90	96.89	98.90	100.94	103.01	105.11	107.23	109.39
1.5	111.57	113.78	116.02	118.29	120.58	122.91	125.26	127.65	130.06	132.51
1.6	134.99	137.49	140.03	142.59	145.19	147.82	150.48	153.17	155.90	158.65
1.7	161.44	164.26	167.11	170.00	172.91	175.86	178.85	181.86	184.91	188.00
1.8	191.11	194.27	197.45	200.67	203.93	207.22	210.54	213.90	217.29	220.72
1.9	224.19	227.69	231.23	234.80	238.41	242.06	245.74	249.46	253.22	257.01
2.0	260.84	264.71	268.62	272.56	276.54	280.57	284.63	288.72	292.86	297.04
2.1	301.25	305.51	309.80	314.13	318.51	322.92	327.38	331.87	336.41	340.98
2.2	345.60	350.26	354.96	359.70	364.48	369.31	374.17	379.08	384.03	389.03
2.3	394.06	399.14	404.26	409.43	414.64	419.89	425.19	430.53	435.91	441.34
2.4	446.82	452.34	457.90	463.51	469.16	474.86	480.60	486.39	492.23	498.11
2.5	504.04	510.02	516.04	522.11	528.22	534.39	540.60	546.86	553.16	559.51
2.6	565.92	572.37	578.86	585.41	592.01	598.65	605.34	612.09	618.88	625.72
2.7	632.61	639.55	646.55	653.59	660.68	667.83	675.02	682.27	689.56	696.91
2.8	704.31	711.76	719.27	726.82	734.43	742.09	749.80	757.57	765.39	773.26
2.9	781.19	789.17	797.20	805.29	813.43	821.62	829.87	838.17	846.53	854.95

Table created 1/12/2005 by Ron Roman, Montana DNRC -- Water Resources Division.
Rating Table No. 4

The regression equation of log discharge on log gage height is: LOG Q = 2.95 x LOG (Gage Height) + 1.53
This equation has an r-squared value of 0.9990

The arithmetic form of this equation is: $Q = 33.71x\ (\text{GAGE HEIGHT})^{2.95}$

TABLE 9. SLATE CREEK RATING TABLE

GAGE HEIGHT (feet)	DISCHARGE (Cubic Feet Per Second)									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04
0.1	0.05	0.06	0.08	0.10	0.12	0.15	0.18	0.21	0.25	0.29
0.2	0.33	0.38	0.43	0.49	0.55	0.61	0.68	0.76	0.84	0.92
0.3	1.01	1.11	1.21	1.32	1.43	1.55	1.67	1.80	1.94	2.09
0.4	2.24	2.40	2.56	2.73	2.91	3.10	3.29	3.49	3.70	3.92
0.5	4.15	4.38	4.62	4.87	5.13	5.39	5.67	5.95	6.25	6.55
0.6	6.86	7.18	7.51	7.85	8.20	8.56	8.92	9.30	9.69	10.09
0.7	10.50	10.92	11.35	11.79	12.24	12.70	13.18	13.66	14.16	14.66
0.8	15.18	15.71	16.25	16.81	17.37	17.95	18.54	19.14	19.76	20.38
0.9	21.02	21.67	22.34	23.01	23.70	24.41	25.12	25.85	26.59	27.35
1.0	28.12	28.90	29.70	30.51	31.34	32.18	33.03	33.90	34.78	35.68
1.1	36.59	37.52	38.46	39.41	40.38	41.37	42.37	43.39	44.42	45.47
1.2	46.53	47.61	48.70	49.81	50.94	52.08	53.24	54.42	55.61	56.82
1.3	58.04	59.28	60.54	61.82	63.11	64.42	65.74	67.09	68.45	69.83
1.4	71.22	72.64	74.07	75.52	76.99	78.47	79.98	81.50	83.04	84.60
1.5	86.18	87.77	89.39	91.02	92.67	94.35	96.04	97.75	99.48	101.22
1.6	102.99	104.78	106.59	108.41	110.26	112.13	114.02	115.92	117.85	119.80
1.7	121.77	123.75	125.76	127.79	129.84	131.92	134.01	136.12	138.26	140.41
1.8	142.59	144.79	147.01	149.25	151.51	153.80	156.11	158.44	160.79	163.16
1.9	165.56	167.97	170.41	172.88	175.36	177.87	180.40	182.95	185.53	188.13
2.0	190.75	193.40	196.07	198.76	201.48	204.22	206.98	209.77	212.58	215.41
2.1	218.27	221.15	224.06	226.99	229.95	232.93	235.93	238.96	242.02	245.09
2.2	248.20	251.33	254.48	257.66	260.86	264.09	267.35	270.63	273.93	277.26
2.3	280.62	284.00	287.41	290.85	294.31	297.79	301.31	304.85	308.41	312.00
2.4	315.62	319.27	322.94	326.64	330.37	334.12	337.90	341.71	345.54	349.40
2.5	353.29	357.21	361.16	365.13	369.13	373.16	377.21	381.30	385.41	389.55
2.6	393.72	397.91	402.14	406.39	410.67	414.98	419.32	423.69	428.09	432.52
2.7	436.97	441.46	445.97	450.51	455.09	459.69	464.32	468.98	473.67	478.39
2.8	483.14	487.93	492.74	497.58	502.45	507.35	512.28	517.24	522.24	527.26
2.9	532.32	537.40	542.52	547.66	552.84	558.05	563.29	568.56	573.87	579.20

Table created 1/72005 by Ron Roman, Montana DNRC -- Water Resources Division.
Rating Table No. 5

The regression equation of log discharge on log gage height is: LOG Q = 2.76 x LOG (Gage Height) + 1.45
This equation has an r-squared value of 0.9990

The arithmetic form of this equation is: $Q = 28.12 \times (\text{GAGE HEIGHT})^{2.76}$

APPENDIX B

INSPECTION CHECKLIST

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
DAM SAFETY INSPECTION REPORT

NAME OF DAM
DATE INSPECTED

INVENTORY NO. ______________
HAZARD CATEGORY __________
TYPE OF DAM ________________
YEAR BUILT __________________

OWNER ________________________
OPERATOR _____________________
STREAM _______________________
DRAINAGE AREA ________________

Reservoir Storage Status

	Water Surface Elevation (feet)	Storage (acre-feet)
At time of inspection	_________	_________
At spillway crest	_________	_________
At min. dam crest elevation	_________	_________

ITEM	YES	NO	REMARKS

1. EMBANKMENT

A. Crest -- Height= Length= Width=

(1) Any visual settlements?			
(2) Any misalignments?			
(3) Any cracking?			
(4) Any traffic damage?			
(5) Other?			

ITEM	YES	NO	REMARKS

1. **EMBANKMENT** (continued)

B. Upstream Face -- Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Is riprap protection adequate?			
(5) Any stone deterioration?			
(6) Any visual settlement, slumps, sloughing, depressions or bulges?			
(7) Adequate grass cover?			
(8) Debris on the dam face?			
(9) Other?			

C. Downstream Face--Slope= 1V on 2H

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Any visual settlement, slumps, sloughing, depressions or bulges?			
(5) Is the toe drain dry?			
(6) Are the relief wells flowing?			
(7) Any boils at the toe?			
(8) Any seepage areas?			
(9) Any traffic or animal damage?			
(10) Any burrowing animals?			
(11) Adequate grass cover?			
(12) Other?			

D. Amount and Type of Vegetation on the Dam

ITEM	YES	NO	REMARKS

2. ABUTMENT CONTACTS

A) Any erosion?			
B) Any visual differential movement?			
C) Any cracks?			
D) Any seepage present?			
E) Other?			

3. OUTLET WORKS

A. Intake Structure -- Size=

(1) Any settlement?			
(2) Any tilting?			
(3) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(4) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(5) Metal appurtenances:			
a. Any corrosion present?			
b. Any breakage present?			
(6) Trash rack?			
a. Condition?			
b. Anchor system secure?			
(7) Other?			

ITEM	YES	NO	REMARKS

3. OUTLET WORKS (continued)

B. Conduit -- Type =

(1) Do concrete surfaces show: NA			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Is the conduit metal?			
a. Any corrosion present?			
b. Protective coatings adequate?			
(4) Is the conduit misaligned?			
(5) Any calcium deposits?			
(6) Other?			

C. Gates and Tower

(1) Gates:			
a. Size: Operating: b. Type: Operating:	Emergency: Emergency:		
(2) Controls operational?			
(3) Controls lubricated?			
(4) Operational problems?			
(5) Leakage around gates?			
(6) Gate seals in good condition?			
(7) Any cavitation damage? If so, describe?			
(8) Describe air vent-size and condition.			

ITEM	YES	NO	REMARKS

3. OUTLET WORKS (continued)

C. Gates and Tower (continued)

(9) Is there a jet pump?			
a. Is it operational?			
b. Leakage?			
(10) Is the tower dry? _____ wet?			
(11) Any seepage in the tower?			
(12) Tower in good condition?			
(13) Any safety problems?			
(14) Ladder in good condition?			
(15) Gate house in good condition?			
(16) Emergency plan completed for the dam?			
a. Posted in the gatehouse?			
(17) Other?			

D. Stilling Basin

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Do energy dissipaters show:			
a. Signs of deterioration?			
b. Are they covered with debris?			
(4) Other?			

ITEM	YES	NO	REMARKS

3. OUTLET WORKS (continued)

E. Downstream Channel

(1) Is the channel:			
a. Eroding or back cutting?			
b. Sloughing?			
c. Obstructed?			
(2) Is released water:			
a. Undercutting the outlet?			
b. Eroding the embankment?			
(3) Other?			

4. SPILLWAY

A. Description

(1) Location?			
(2) Type of Spillway?			
(3) Size of Spillway?			
(4) Spillway lining?			
(5) Is there a weir?			
(6) Is the spillway in good condition?			
(7) Any drains?			
a. Describe the condition of drains.			

B. Does spillway show:

(1) Any cracking concrete?			
(2) Any spalling concrete?			
(3) Any exposed reinforcement in the concrete?			
(4) Any erosion?			

ITEM	YES	NO	REMARKS

4. SPILLWAY (continued)

B. Does spillway show: (continued)

(5) Any slope sloughing?			
(6) Any obstructions?			
(7) Displacement or offset joints?			
(8) Loss of joint material?			
(9) Leakage at the joints?			
(10) Other?			

C. Do the energy dissipaters show:

(1) Signs of deterioration?			
(2) Any cracking?			
(3) Any spalling?			
(4) Any exposed reinforcement?			
(5) Are they covered with debris?			
(6) Other?			

D. Has release water:

(1) Eroded the embankment?			
(2) Undercut the outlet?			
(3) Eroded the downstream channel?			
(4) Other?			

E. Emergency Spillway

(1) Is there an emergency spillway?			(If YES, describe)

ITEM	YES	NO	REMARKS

5. RESERVOIR CONTROL

A) Recent upstream development?			
B) Recent downstream development?			
C) Slides in reservoir area?			
D) Change in reservoir operation?			
E) Large impoundment upstream?			
F) Any debris in the reservoir?			
G) Other?			

6. INSTRUMENTATION

A) List type(s) of instrumentation:.			
B) In good condition?			
C) Read periodically?			
D) Is data available?			
E) Include all data gathered since last report.			

7. DOWNSTREAM CONDITION

A. Downstream Land Use.

This dam was inspected by:

Additional comments and recommendations.

APPENDIX C
MONITORING WELL LOGS

MONTANA DNRC

SOIL LOG OF BOREHOLE NO: DH1

(Page 1 of 3)

MT DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/8/2004
DATE COMPLETED : 9/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles/Bob Arrington
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube

Depth in Feet	Surf. Elev. 4743.0	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd / Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
0	4743		0 to 2' ROAD BASE, gravelly sand, brown, dry	GP	░							
			2 to 35' CLAYEY SAND, brown, slightly moist to moist, w/ scattered gravels	SC	▨							
5	4738	☒	At 5 to 6.5' brown, dry, scattered granite gravel fragments		▨	SS	9 10 11	33	18/18	100%		
10	4733	☒	At 10 to 11.5' brown, moist, w/ some gravel		▨	SL	12 10 8	17	18/18	100%	3.2	10 to 11.5' Torvane = 1.6 tsf
15	4728	☒	At 15 to 16.5' sandy clay, brown, moist, w/ scattered gravel		▨	SS	5 6 11	15	18/18	100%		15 to 16.5' % Finer #200 = 38%
20	4723	☒	At 20 to 21.5' brown, moist, w/ scattered gravel		▨	SL	6 13 13	19	18/18	100%	5.0	At 20.5 to 21.5' Torvane (sm) = >25??
25	4718	☒	25 to 40' LEAN CLAY at 25 to 26.5, brown, moist, w/ scattered gravel	CL	▨	SS	11 16 30	11	18/18	100%		
30												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-18-2006

SOIL LOG OF BOREHOLE NO: DH1

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RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/8/2004
DATE COMPLETED : 9/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman
DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles/Bob Arrington
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube

Depth in Feet	Surf. Elev. 4743.0	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
30	4713	☒		CL	▨	ST			6/30	20%		
35	4708	☒	at 35 to 36.5' brown, grey-brown, moist			SL	7 8 14	14	18/18	100%	3.3	At 35 to 36.5' %Finer #200 = 60 DS Test: c = 1.65 psi phi = 25.4 LL=38, PL=21, PI=17 Torvane (small) = 25 tsf
40	4703	☒	At 40 to 50, CLAYEY SAND	SC	▒	ST			12/30	40%		40 to 41' % Finer #200 = 34% LL=32, PL=18, PI=14 Dry Unit Weight = 105.8 pcf m = 17.2% Consolidation Test: see lab report Pinhole Dispersion = ND1
45	4698	☒	At 45 to 46.5' brown, moist, w/ scattered gravel			SL	9 9 14	13	18/18	100%	2.5	45 to 46.5' Torvane (small) = 12.5 tsf
50	4693	☒	50 TO 60' SILTY SAND At 50 to 51.5' brown, moist, w/ scattered gravel	SM	░	SS	7 12 13	16	18/18	67%		50 to 51.5' % Finer #200 = 28% DS Test: c = 0.79 psi phi = 31.4 LL=23, PL=19, PI=4
55	4688	☒	At 55 to 56.5' grey-brown, moist, w/ scattered gravel			SL	12 14 23	18	18/18	100%	2.7	At 55 to 56.5' % Finer #200 = 26% Dry Unit Weight = 123.4 pcf m = 11.1% Torvane (small) = 12.5 tsf
60												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-18-2006

SOIL LOG OF BOREHOLE NO: DH1

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DATE STARTED : 9/8/2004
DATE COMPLETED : 9/9/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles/Bob Arrington
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube

Depth in Feet	Surf. Elev. 4743.0	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
60	4683	☒	60 to 80' CLAYEY SAND At 60 to 61.5' grey-brown, moist, w/ scattered gravel	SC		SS	9 8 12	12	18/18	100%		
65	4678	☒	At 65 to 66.5' brown, moist, stiff, w/ scattered gravel			SL	4 8 17	12	18/18	100%	4.3	At 65.5 to 66.5' Torvane (small) = 10.75 tsf
70	4673	☒				ST			26/30	87%		At 70 to 72.5' % Finer #200 = 48% LL=33, PL=19, PI=14 Dry Unit Weight = 102.6 pcf m = 20.9% Pinhole Dispersion = ND1 Triaxial Shear (see report) Consolidation (see report) Permeability = 5.6 x 10(-7)
75	4668	☒	At 75 to 76.5' pale brown, dark grey, moist, some organics			SS	- 20 24	24	12/18	67%		
80	4663	☒	80 to 86.5' SILTY SAND At 80 to 81.5' pale brown, slightly moist, w/ scattered gravel	SM		SL	14 15 25	17	18/18	100%		At 80 to 81.5' % Finer #200 = 40% LL=26, PL= 22, PI=4 Double hydr. % dispersion = 84.7%
85	4658	☒	85' BOTTOM OF HOLE At 85 to 86.5' pale brown, moist, w/ scattered gravel			SS	8 25 22	24	18/18	100%		
90												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-18-2006

WELL COMPLETION LOG NO: DH1

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MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/8/2004
DATE COMPLETED : 9/10/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : Split Spoon
LOGGED BY : Bob Arrington/Craig Stiles
APPROVED BY : Brian Grant

Depth In Feet	Surf. Elev. 4743.0
0	4743
5	4738
10	4733
15	4728
20	4723
25	4718
30	4713
35	4708
40	4703
45	4698
50	4693
55	4688
60	4683
65	4678
70	4673
75	4668
80	4663
85	4658
90	

Well Construction Information

WELL CONSTRUCTION
Date Compl. : 10/8/2004
Hole Diameter : 8 inch
DNRC Rep. : Bob Arrington

STANDPIPE
Material : PVC pipe
Diameter : 1 inch
Joints : screwed
Bottom Cap : glued

WELL SCREEN
Material : PVC pipe
Diameter : 1 inch
Length : 5 feet
Opening : .02 inch

SAND PACK
Material : Colorado Silica 10/20

ANNULUS
Material : 3/8 inch Bentonite

WELL COVER
Diameter : 8 inches
Height : 12 inches

NOTES:

Surface Elev: 4743.00 feet (estimate)

DH1A TOP Elev: 4742.20 feet

DH1B TOP Elev: 4742.10 feet

Top of Cover Elev: 4742.5 feet (estimate)

Northing:

Easting:

Surveyed By: Larry Schock

Date Surveyed: 10/26/2004

DESCRIPTION

1 to 5' SAND

5 to 36' BENTONITE

36 to 47' SAND

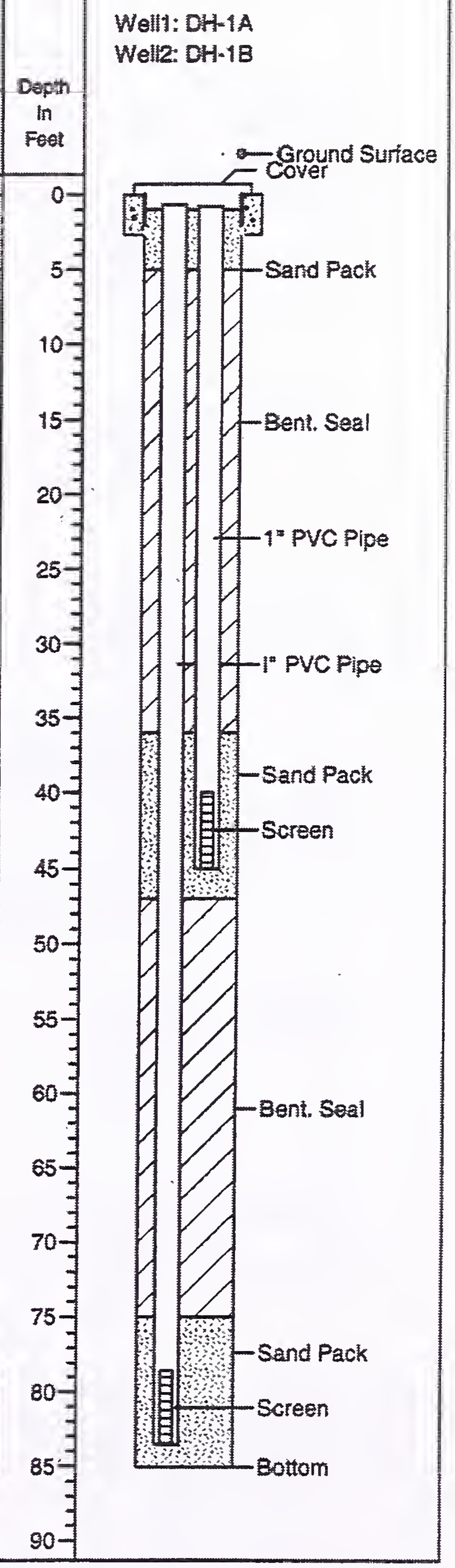
40 to 45' DH1B SCREEN

47 to 75' BENTONITE

75 to 85' SAND

78.5 to 83.5' DH1A SCREEN

85' BOTTOM OF HOLE



MONTANA DNRC

SOIL LOG OF BOREHOLE NO: DH2

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MT DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/10/2004
DATE COMPLETED : 9/14/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger/Core
SAMPLING METHOD : Split Spoon/HQ Core Barre
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube
HQ Core Barrel

Depth in Feet	Surf. Elev. 4743.0	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
0	4743		0 to 5' Road Base, sandy with gravel, brown, dry	GP								
5	4738	☒	At 5 to 6.5' Silty clayey sand, w/ gravel, brown, dry			SS	3 3 3	6	12/18	67%		
10	4733	☒	At 10 to 11.5' brown, slightly moist, high plasticity	SC		SL	6 5 4	7	16/18	89%	1.5	10 to 11.5' Torvane = 3.25 tsf % Finer #200 = 12% LL=25, PL=19, PI=6 Dry Unit Weight = 101.9 pcf m = 11.7%
			At 15 to 16' w/gravel, brown, moist; bottom 15.5 to 16 consists of weathered granite bedrock fragments									
15	4728	☒				SS	7 50+		12/18	67%		
			At 16 to 85' COARSE-GRAINED GRANITE, pink, equigranular									16 to 20' Cored 4' Recovered 4' 100% RQD = 75% Frax Orientation = vert. and 45% to core axis
20	4723			GR								20 to 25' Recovery 90% Fault or frax at 21.9' RQD = 20%
25	4718											25 to 30' Rubbly and fractured, Rec. = 60% RQD = 25% Frax/ft. = too rubbly to estimate
30												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-18-2006

SOIL LOG OF BOREHOLE NO: DH2

(Page 2 of 3)

MT DEPARTMENT OF NATURAL
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RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/10/2004
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DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger/Core
SAMPLING METHOD : Split Spoon/HQ Core Barre
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube
HQ Core Barrel

Depth in Feet	Surf. Elev. 4743.0	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
30	4713											30 to 35' 100% recovery RQD = 52% Frax at 60 30 deg to c.axis and vert. and horiz. Frax/ft = 3 to rubbly
35	4708											35 to 40' 100% recovery, RQD = 78% Frax/ft = 3
40	4703											40 to 45' 100% recovery, RQD = 88% Frax at 35 - 40 deg to c.a. and hor. and vert. Frax/ft = 2 to 3
45	4698			GR								45 to 50' 100% recovery, RQD = 85% Frax/ft = 3+ Frax orientation = 35 deg, 40 deg, horiz. and vert.
50	4693											50 to 52' 40% recovery, RQD = 20% Frax/ft = 3+
			At 52 to 55' Granitic sand and rubble filling void (lost circulation temporarily), may be open vertical fracture, solid granite again at 55'									52 to 55' rubble filled void
55	4688											55 to 60' 100% recovery, RQD = 50% Frax/ft = 3 Frax orientation = 65deg, 35deg, hor., vert.
60												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-TB-2006

SOIL LOG OF BOREHOLE NO: DH2

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MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/10/2004
DATE COMPLETED : 9/14/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger/Core
SAMPLING METHOD : Split Spoon/HQ Core Barrel
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube
HQ Core Barrel

Depth in Feet	Surf. Elev. 4743.0	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
60	4683											60 to 65' 100% recovery, RQD = 68% Frax/ft =3 Frax orientation = 65/40/70 degrees
65	4678											65 to 70' 100% recovery, RQD = 50%, Frax/ft = 3+, Orientation = vert./hor.
70	4673											70 to 75' 100% recovery, RQD = 50%, Frax/ft = 2-3, orientation = vert./hor./50degrees
				GR								
75	4668											75 to 77.5' 80% rec., RQD = 38%, Frax/ft = 5+ broken and rubbly ground
			At 77 to 79' Very broken and rubbly zone									77.5 to 80' 40% rec., RQD = 17%, rubbly, broken ground,
80	4663		At 80 to 82' very broken and rubbly zone, lost circulation									80 to 82' 42% recovery, RQD = 0% all rubble and broken granite (lost circulation)
												82 to 85' 100% recovery, RQD = 64% Frax/ft = 3+ Frax. orient. = 30/40 deg & horiz.
85	4658		85' BOTTOM OF HOLE									
90												

Hammer 140 lbs 30" drop hydraulic
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-18-2006

WELL COMPLETION LOG NO: DH2

(Page 1 of 1)

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RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/10/2004
DATE COMPLETED : 9/14/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : HW Case Advance/Core
SAMPLING METHOD : Split Spoon
LOGGED BY : Craig Stiles
APPROVED BY : Brian Grant

Depth In Feet	Surf. Elev. 4743.0
0	4743
5	4738
10	4733
15	4728
20	4723
25	4718
30	4713
35	4708
40	4703
45	4698
50	4693
55	4688
60	4683
65	4678
70	4673
75	4668
80	4663
85	4658
90	

Well Construction Information

WELL CONSTRUCTION

Date Compl. : 9/14/2004
Hole Diameter : 4.25 inch
DNRC Rep. : Craig Stiles

STANDPIPE

Material : PVC pipe
Diameter : 1 inch
Joints : screwed
Bottom Cap : glued

WELL SCREEN

Material : PVC pipe
Diameter : 1 inch
Length : 5 feet
Opening : .02 inch

SAND PACK

Material : Colorado Silica 10/20

ANNULUS

Material : 3/8 inch Bentonite

WELL COVER

Size : 4" x 4" square
Length : 5 feet

NOTES:

Surface Elev: 4743.0 feet (estimate)

DH2A TOP Elev: 4745.75 feet

DH2B TOP Elev: 4745.82 feet

Top of Cover Elev: 4746.00 feet (estimate)

Northing:

Easting:

Surveyed By: Larry Schcck.

Date Surveyed: 10/26/2004

DESCRIPTION

0 to 5' SAND

5 to 42.5' BENTONITE

42.5 to 56.5' SAND

49.5 to 54.5' DH2B SCREEN

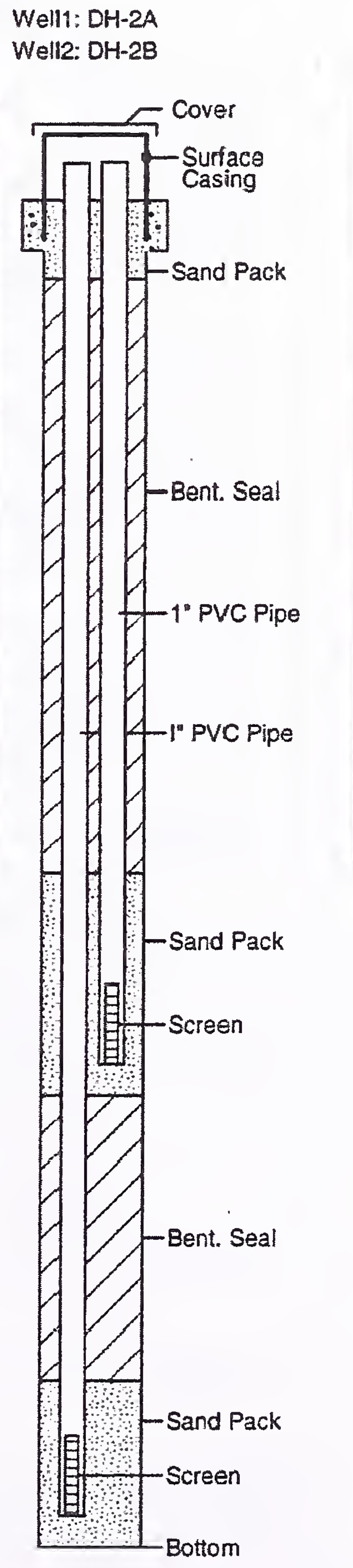
56.5 to 74.5' BENTONITE

74.5 to 85' SAND

78 to 83' DH2A SCREEN

85' BOTTOM OF HOLE

Depth In Feet



MONTANA DNRC

SOIL LOG OF BOREHOLE NO: DH3

(Page 1 of 3)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/29/2004
DATE COMPLETED : 9/30/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger/Core
SAMPLING METHOD : Split Spoon/HQ Core Barrel
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube
HQ Core Barrel

Depth in Feet	Surf. Elev. 4616.3	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
0	4616		0 to 18' sandy gravel, with scattered cobbles									
			At 4.5 to 5.5 Large cobble									
5	4611											
		☒	At 6 to 7.5 brown, gravel pieces up to 1.5", no plasticity			SS	8 21 50	101	4/18	22%		
				GW								
10	4606											
		☒	At 11 to 12.5 brown, gravel pieces up to 2" angular			SL	8 7 8	14	6/18	33%		
15	4601											
		☒	At 16 to 17.5' brown, angular rock fragments			SS	4 3 8	37	6/18	23%		
			18 to 54' Sandy gravel to cobbly sandy gravel									
20	4596											
		☒	21 to 22.5' Switched to core at 21' cored 21 to 23.5'			SL	+50		0	0%		Began coring at 21'
		☒	23 to 24.5' Gravelly sand, grey, angular rock fragments up to 1"	GW		SS	17 +50		7/10	70%		At 23.5 to 27' recovered 6" total; 2" of granitic core and rubble of mixed compositions, not native to immediate area
25	4591											
												At 27 to 29.5' recovered 3, 4" pieces of granite and 3" of mixed lithology river cobbles
30												

Hammer 140 lbs 30" drop cathead rope
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-18-2006

2007

SOIL LOG OF BOREHOLE NO: DH3

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MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/29/2004
DATE COMPLETED : 9/30/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger/Core
SAMPLING METHOD : Split Spoon/HQ Core Barre
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube
HQ Core Barrel

Depth in Feet	Surf. Elev. 4616.3	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
30	4586											At 29.5 to 32 recovered 2, 3" pieces of granite and 2" of various rock fragments
												At 32 to 34.5 recovered 1, 3" granite piece and 3" of various rock fragments
35	4581											At 34.5 to 36.0' recovered 2, 3" core pieces and 2" of mixed rock fragments
												At 36 to 37' recovered 1, 3" granite core piece, (2) 2" pieces and 1" of other material
40	4576											At 37 to 40' recovered one 4" granitic core piece and various rock fragments
				GW								At 40 to 42' broken granite core pieces and other lithologies mixed in
45	4571											At 42 to 47' cored very easily; gravelly sand layer, lot of sand exiting top of casing, no recovery
		☒				SS	15 20 34	37	6/18	33%		At 47 to 48.5' recovered 6" of varied rock fragments and sandy gravel, brn, in split spoon sample
50	4566											At 48.5 to 52.0' recovered one 3" granite core piece and 4" of various rock fragments
												At 52 to 54' granite bedrock at about 53'
55	4561		54 to 62.5 GRANITE, pink, coarse-grained, equigranular									At 54 to 56.8' recovery = 75%, three dominant frax sets @ hor., 45deg, 20deg
				GR								At 56.8 to 61.8' recovery = 90%, RQD = 32% water bearing frax at 58' and 60'
60												

Hammer 140 lbs 30" drop cathead rope
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

SOIL LOG OF BOREHOLE NO: DH3

(Page 3 of 3)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/29/2004
DATE COMPLETED : 9/30/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger/Core
SAMPLING METHOD : Split Spoon/HQ Core Barre
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube
HQ Core Barrel

Depth in Feet	Surf. Elev. 4616.3	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
60	4556			GR	▨							At 61.8 to 62.5' recovery = 100%, RQD = 48%
			62.5 BOTTOM OF HOLE									
65	4551											
70	4546											
75	4541											
80	4536											
85	4531											
90												

Hammer 140 lbs 30" drop cathead rope
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-18-2006

WELL COMPLETION LOG NO: DH3

(Page 1 of 1)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/29/2004
DATE COMPLETED : 9/30/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman

DRILL RIG : BK-66
DRILLING METHOD : HW Case Advance/Core
SAMPLING METHOD : Split Spoon
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

Depth In Feet	Surf. Elev. 4616.3
0	4616
5	4611
10	4606
15	4601
20	4596
25	4591
30	4586
35	4581
40	4576
45	4571
50	4566
55	4561
60	4556
65	4551
70	

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 9/30/2004
Hole Diameter	: 4.25 inch
DNRC Rep.	: Bob Arrington

STANDPIPE

Material	: PVC pipe
Diameter	: 1 inch
Joints	: screwed
Bottom Cap	: glued

WELL SCREEN

Material	: PVC pipe
Diameter	: 1 inch
Length	: 5 feet
Opening	: .02 inch

SAND PACK

Material	: Colorado Silica 10/20

ANNULUS

Material	: 3/8 inch Bentonite

WELL COVER

Size	: 4" x 4" square
Length	: 5 feet

NOTES:

Surface Elev: 4616.3 feet (estimate)

DH3A TOP Elev: 4618.80 feet

DH3B TOP Elev: 4618.89 feet

Top of Cover Elev: 4619.4 feet (estimate)

Northing:

Easting:

Surveyed By: Larry Schock

Date Surveyed: 10/26/2004

DESCRIPTION

0 to 5' SAND

5 to 18' BENTONITE

18 to 26' SAND

21 to 26' DH3B SCREEN

26 to 49' NATIVE MATERIAL (caved-in)

49 to 56' BENTONITE

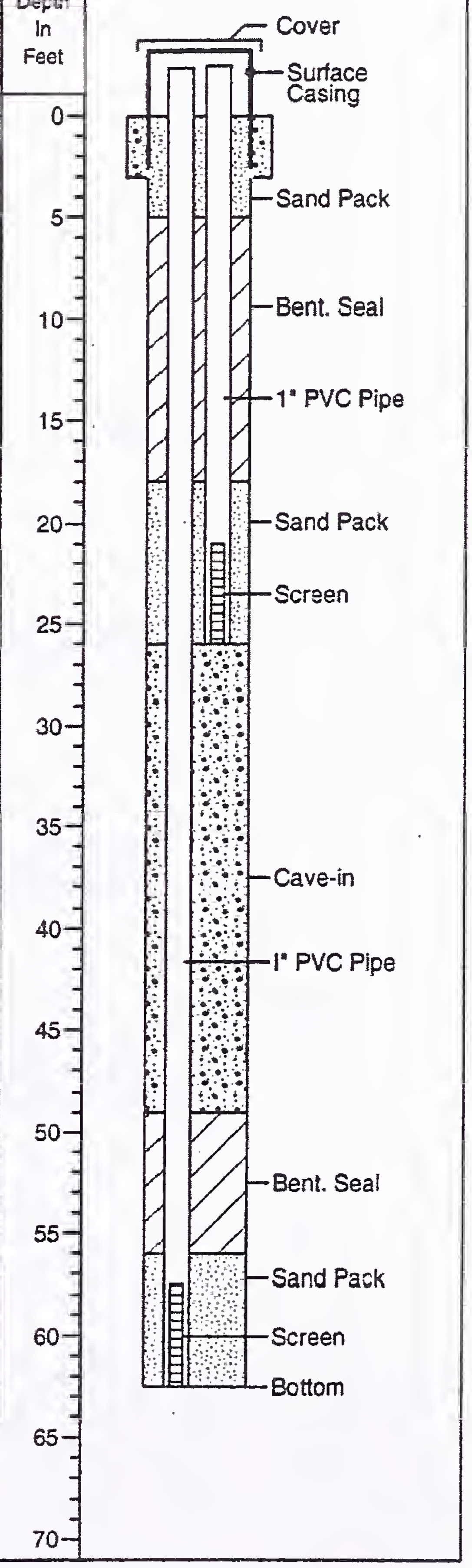
53' Bedrock (Granite)

56 to 62.5' SAND

57.5 to 62.5' DH3A SCREEN

62.5' BOTTOM OF HOLE

Well1: DH-3A
Well2: DH-3B



SOIL LOG OF BOREHOLE NO: DH4

(Page 1 of 3)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR	: PAINTED ROCKS	DRILL RIG	: BK-66
DATE STARTED	: 9/29/2004	DRILLING METHOD	: Hollow Stem Auger/Core
DATE COMPLETED	: 9/30/2004	SAMPLING METHOD	: Split Spoon/HQ Core Barre
DRILL COMPANY	: Ruen Drilling	LOGGED BY	: Bob Arrington
DRILLER	: Jim Erdman	APPROVED BY	: Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube
HQ Core Barrel

Depth in Feet	Surf. Elev. 4630.6	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
0	4630		0 to 16.3' sandy gravel to gravelly sand, with scattered cobbles									
5	4625											
		☒	At 6.5 to 8' sandy gravel, brown, cobble in shoe	GW		SS	30 25 48	100	14/18	78%		
10	4620											
		☒	At 11.5 to 13' Sandy gravel, brown			SS	9 7 9	16	5/18	28%		
15	4615											
			At 16.3 to 47' Granite cobbles and boulders, pink, with interstitial sands and gravels									At 16.3' began coring
20	4610											
		☒	At 21.5 to 23' attempted split spoon sample, got some gravelly sand	GW		SS	9 23 42	55	8/18	44%		At 21.5 to 23.0' % Finer #200 =7.4
25	4605											
30												

Hammer 140 lbs 30" drop cathead rope
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-18-2006

MONTANA DNRC

SOIL LOG OF BOREHOLE NO: DH4

(Page 2 of 3)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR : PAINTED ROCKS
DATE STARTED : 9/29/2004
DATE COMPLETED : 9/30/2004
DRILL COMPANY : Ruen Drilling
DRILLER : Jim Erdman
DRILL RIG : BK-66
DRILLING METHOD : Hollow Stem Auger/Core
SAMPLING METHOD : Split Spoon/HQ Core Barre
LOGGED BY : Bob Arrington
APPROVED BY : Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube
HQ Core Barrel

Depth in Feet	Surf. Elev. 4630.6	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
30	4600											
		☒	At 32 to 33.5' gravel fragments	GW		SS	+50		0	0%		
35	4595											
40	4590											
45	4585											
			At 47 to 48.5 River gravels of various composition	GP								
50	4580		At 48.5 to 51 Granite cobbles and boulders or debris from adjacent cliffs	GP								
			At 51 to 62' River gravels and cobbles	GP								
55	4575											
60												

Hammer 140 lbs 30" drop cathead rope
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

SOIL LOG OF BOREHOLE NO: DH4

(Page 3 of 3)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR	: PAINTED ROCKS	DRILL RIG	: BK-66
DATE STARTED	: 9/29/2004	DRILLING METHOD	: Hollow Stem Auger/Core
DATE COMPLETED	: 9/30/2004	SAMPLING METHOD	: Split Spoon/HQ Core Barrel
DRILL COMPANY	: Ruen Drilling	LOGGED BY	: Bob Arrington
DRILLER	: Jim Erdman	APPROVED BY	: Brian Grant

SAMPLER TYPE
SS Split spoon
SL Split Spoon Brass Liners
ST Shelby Tube
HQ Core Barrel

Depth in Feet	Surf. Elev. 4630.6	Sample Interval	DESCRIPTION	USCS	GRAPHIC	Sampler Type	Blow Count	Adjusted Blow Counts (blows/foot)	Inches Recoverd Inches Driven	% Recovery	Pocket Penetrometer (tons/square foot)	REMARKS
60	4570			GP								
62			At 62 to 80' Granite, coarse-grained, pink, equigranular	GR								
62			At 62 to 76' more sand-filled fractures and open spaces in the granite bedrock									
65	4565											
70	4560											
75	4555											
76			At 76 to 80' more competent, less fractured granite bedrock									
80	4550		80' END OF HOLE									
85	4545											
90												

Hammer 140 lbs 30" drop cathead rope
Standard Spoon OD 2.0" ID 1.5"
Brass Liner Spoon OD 2.5" ID 2.0"

12-18-2006

WELL COMPLETION LOG NO: DH4

(Page 1 of 1)

MT DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
P.O. Box 201601
Helena, MT 59601-1601
(406) 444-6646

RESERVOIR	: PAINTED ROCKS	DRILL RIG	: BK-66
DATE STARTED	: 9/30/2004	DRILLING METHOD	: HW Case Advance/Core
DATE COMPLETED	: 10/1/2004	SAMPLING METHOD	: Split Spoon
DRILL COMPANY	: Ruen Drilling	LOGGED BY	: Bob Arrington/Craig Stiles
DRILLER	: Jim Erdman	APPROVED BY	: Brian Grant

Depth In Feet	Surf. Elev. 4630.6	Depth In Feet
0	4630	0
5	4625	5
10	4620	10
15	4615	15
20	4610	20
25	4605	25
30	4600	30
35	4595	35
40	4590	40
45	4585	45
50	4580	50
55	4575	55
60	4570	60
65	4565	65
70	4560	70
75	4555	75
80	4550	80
85	4545	85
90		90

Well Construction Information

WELL CONSTRUCTION
Date Compl. : 10/1/2004
Hole Diameter : 4.25 inch
DNRC Rep. : B Arrington/C Stiles

STANDPIPE
Material : PVC pipe
Diameter : 1 inch
Joints : screwed
Bottom Cap : glued

WELL SCREEN
Material : PVC pipe
Diameter : 1 inch
Length : 5 feet
Opening : .02 inch

SAND PACK
Material : Colorado Silica 10/20

ANNULUS
Material : 3/8 inch Bentonite

WELL COVER
Size : 4" x 4" square
Length : 5 feet

NOTES:

Surface Elev: 4630.57 feet (estimate)

DH4A TOP Elev: 4633.07 feet

DH4B TOP Elev: 4633.09 feet

Top of Cover Elev: 4633.5 feet (estimate)

Northing:

Easting:

Surveyed By: Larry Schock

Date Surveyed: 10/26/2004

DESCRIPTION

0 to 5' SAND

5 to 10' BENTONITE

10 to 25' Native Material (Caved-in)

Bentonite bridged in HW casing at 25 feet. Had to pull all casing out of hole. Hole caved from 10 to 25 feet.

25 to 33' BENTONITE

33 to 45' SAND

40 to 45' DH4B SCREEN

45 to 61' NATIVE MATERIAL (caved-in)

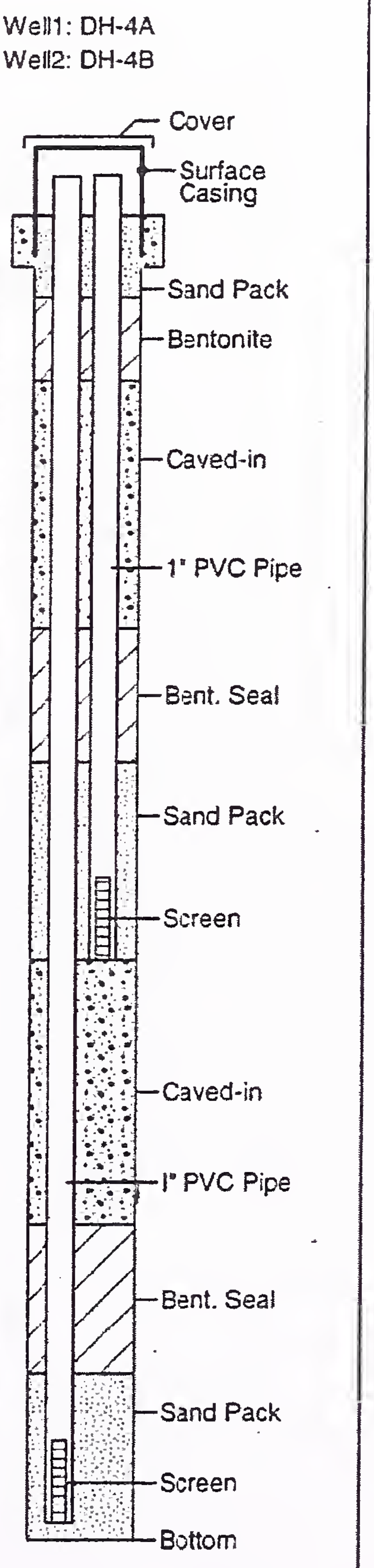
HW casing went to 45 feet. When the HQ casing was pulled out after bentonite was placed to 61 feet, hole caved from 45 to 61 feet.

61 to 70' BENTONITE
62' Bedrock (Granite)

70 to 80' SAND

74 to 79' DH4A SCREEN

80' BOTTOM OF HOLE



APPENDIX D

DISTRUBUTION LIST

PAINTED ROCKS DISTRUBUTION LIST

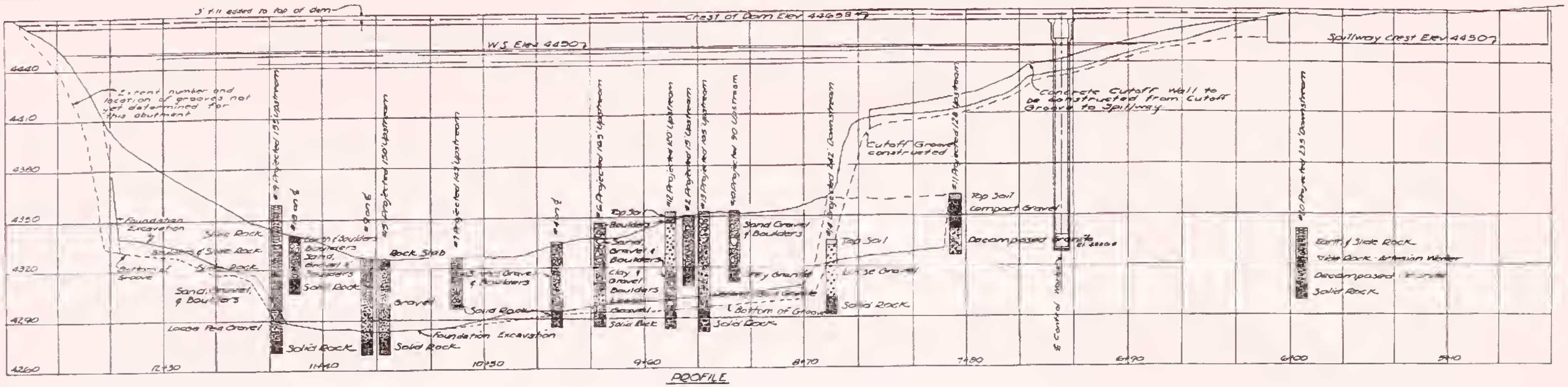
	Number Of Copies
1. State Water Projects Bureau	7
Kevin Smith	
Rob Kingery	
Dam Safety Engineer (2)	
Brandon Watne	
Dolores Eustice	
2. DNRC Information Services Section	
Dan Bushnell	
3 DNRC Missoula Regional Office	1
4. DNRC Dam Safety	1
5. Water Users	3
J.R Iman – President	
Roger Raynal – Vice President	
Gary Boyer -- Secretary	
6. Dam Operator	2
Dam Operator (Al Pernichele)	
Gate house	
7. State Library – Attn: Jennie Stapp	4
8. Extra	2
==	
TOTAL	21

APPENDIX E

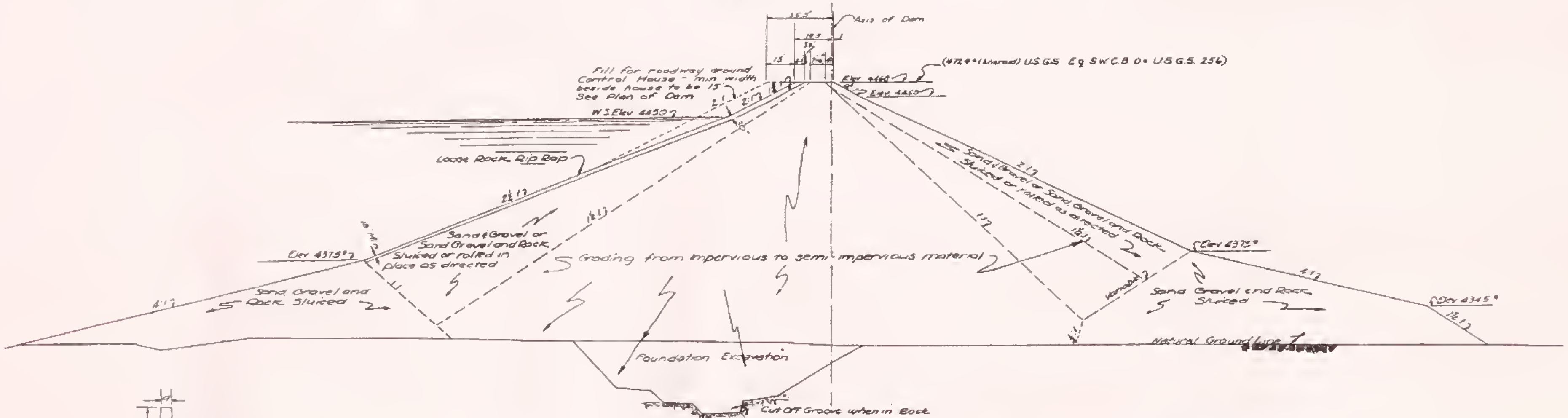
PROJECT DRAWINGS

(NOTE: These reduced project drawings are design drawings and not "As Builts". These drawing should be used for reference only. The SWPB has the full size project drawings.)

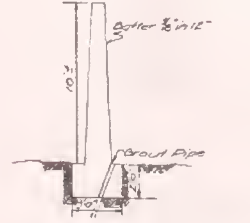
(NOTE: To correct the enclosed 1938 and 1976 project drawing elevations to current corrected USGS elevations, add 275.5 feet.)


3' fill added to top of dam
Crest of Dam Elev 4465.9±
W.S. Elev 4450
Spillway Crest Elev 4450
Extent number and location of grooves not yet determined for this abutment
Concrete Cutoff wall to be constructed from Cutoff Groove to Spillway
Cutoff Groove constructed
Foundation Excavation
Slide Rock
Boulders & Slide Rock
Bottom of Groove
Sand, Gravel, & Boulders
Loose Pea Gravel
Solid Rock
Earth & Boulders
Boulders
Sand, Gravel & Boulders
Rock Slab
Gravel
Sand Gravel & Boulders
Top Soil
Clay & Gravel Boulders
Grey Granite
Bottom of Groove
Loose Gravel
Compact Gravel
Decomposed Granite
Earth & Slide Rock
Slide Rock - Artesian Water
Decomposed Granite
℄ Control House
#9 Projected 135' Upstream
#9 on ℄
#9 on ℄
#5 Projected 150' Upstream
#7 Projected 143' Upstream
#4 on ℄
#6 Projected 125' Upstream
#12 Projected 120' Upstream
#2 Projected 15' Upstream
#13 Projected 105' Upstream
#8 Projected 90' Upstream
#14 Projected 242' Downstream
#11 Projected 128' Upstream
#10 Projected 235' Downstream
4440
4410
4380
4350
4320
4290
4260
12+30
11+40
10+50
9+60
8+70
7+80
6+90
6+00
5+10

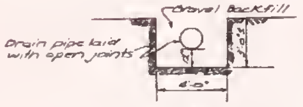
PROFILE
Scale 1"=30'


Axis of Dam
15.5'
(4724± (Aneroid) U.S.G.S. Eq S.W.C.B. 0= U.S.G.S. 256)
Elev 4468
Elev 4465
Fill for roadway around Control House - min width beside house to be 15' See Plan of Dam
W.S. Elev 4450
Loose Rock Rip Rap
2½:1
2½:1
1½:1
Sand & Gravel or Sand Gravel and Rock Sluiced or rolled in place as directed
Grading from impervious to semi impervious material
Sand & Gravel or Sand Gravel and Rock Sluiced or rolled as directed
Elev 4375±
Elev 4375±
Elev 4345±
Sand Gravel and Rock Sluiced
Sand Gravel and Rock Sluiced
4:1
4:1
Natural Ground Line
Foundation Excavation
Cut Off Groove when in Rock

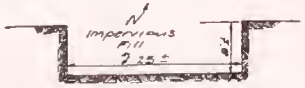
TYPICAL MAXIMUM SECTION
SCALE 1"=30'



DETAIL OF CUT OFF WALL



TYPICAL DRAIN TRENCH
Scale 1"=4'



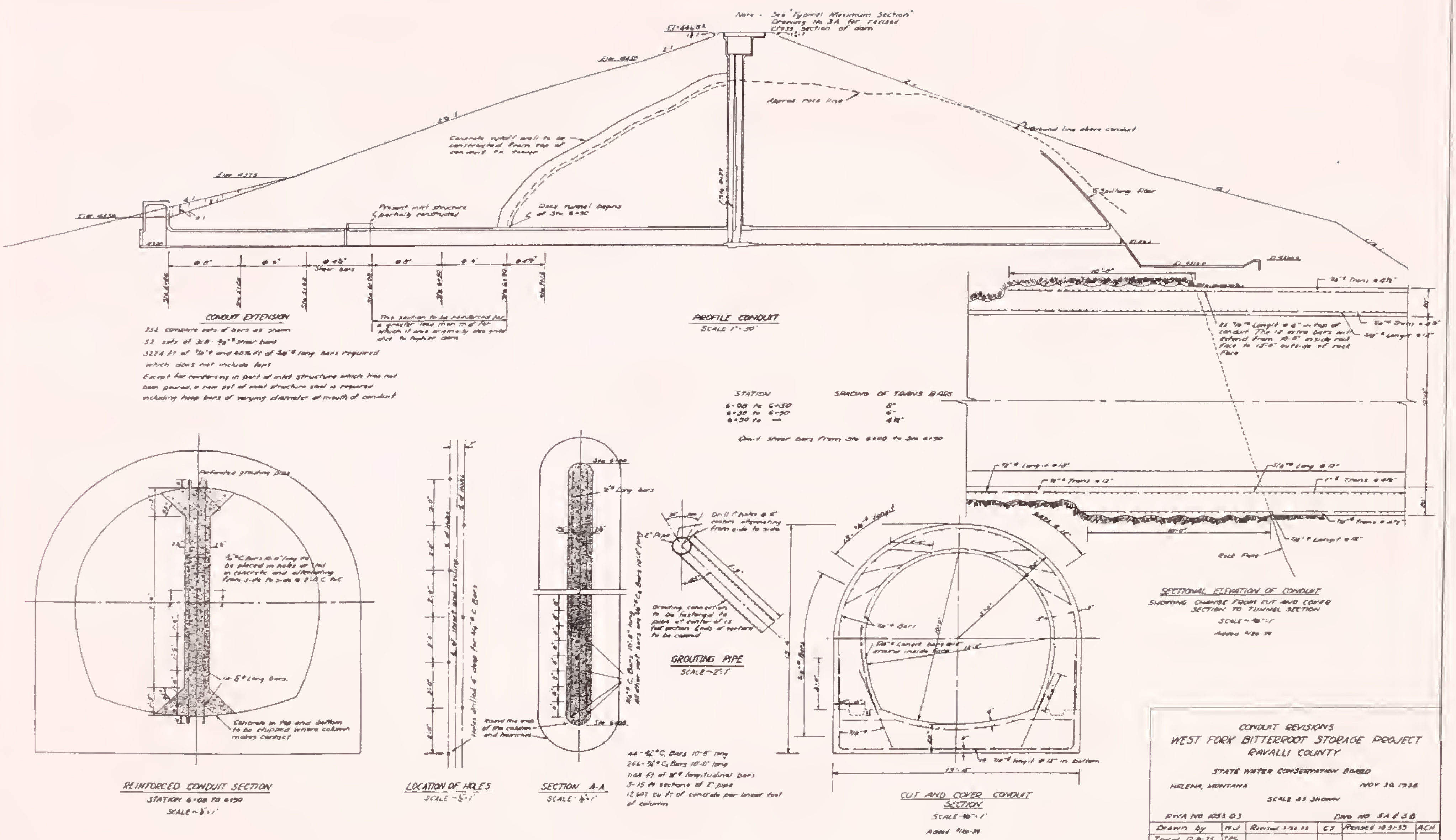
TYPICAL SECTION OF CUT OFF GROOVE

CAPACITY TABLE

Contour Interval	Area Acres	Acre Feet Storage
4330	3	0
4340	33	162
4350	62	650
4360	112	1523
4370	149	2823
4380	193	4557
4390	252	6808
4400	299	9516
4410	341	12759
4420	417	16551
4430	486	21070
4440	557	26300
4450	635	32342
4460	732	39301
4470	824	47083
4480	909	55726
4490	1012	65309
4500	1113	75936

4350 OUTLET ELEV

DETAILS OF DAM
WEST FORK OF BITTERROOT
STORAGE PROJECT
RAVALLI COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONTANA OCT 1938
SCALE AS SHOWN
P.W.A. NO. 1053 DWG NO 3A
Drawn by NBB | Revised 1-13-39 | SRW | Traced by JPS 12/28/38


Note - See "Typical Maximum Section" Drawing No 3A for revised cross section of dam
El: 4468.2
Elev 4450
2:1
2.5:1
Elev 4373
Elev 4350
4:1
3:1
Concrete cutoff wall to be constructed from top of conduit to tower
Approx rock line
Ground line above conduit
Spillway floor
Present inlet structure partially constructed
Rock tunnel begins at Sta 6+90
@ 8"
@ 6"
@ 4½"
Shear bars
This section to be reinforced for a greater load than that for which it was originally designed due to higher dam
10'-0"
⅞"⌀ Trans @ 4½"
25-⅞"⌀ Longit @ 6" in top of conduit. The 18 extra bars will extend from 10-0" inside rock face to 15-0" outside of rock face
⅝"⌀ Longit @ 12"
⅞"⌀ Longit @ 12"
1"⌀ Trans @ 4½"
Rock Face
Perforated grouting pipe
¾" C Bars 10'-6" long to be placed in holes drilled in concrete and alternating from side to side @ 3' C to C
10-⅝"⌀ Long bars
Concrete in top and bottom to be chipped where column makes contact
Holes drilled 4" deep for ¾" C Bars
Sta 6+90
Sta 6+08
2"⌀ Long bars
¾"⌀ C₁ Bars 10'-6" long
All other vert bars are ⅝"⌀ C₂ Bars 10'-0" long
Round the ends of the column and haunches
Drill ⅝" holes @ 6" centers alternating from side to side
2" Pipe
Grouting connection to be fastened to pipe at center of 15 foot section. Ends of sections to be capped
⅞"⌀ Bars
⅝"⌀ Longit bars around inside face
15 ⅞"⌀ Longit @ 12" in bottom
19'-6"

PROFILE CONDUIT

SCALE 1" = 30'

CONDUIT EXTENSION

152 complete sets of bars as shown

33 sets of 3-8 - ⅞"⌀ shear bars

3224 ft of ⅞"⌀ and 6076 ft of ⅝"⌀ long bars required which does not include laps

Except for reinforcing in part of inlet structure which has not been poured, a new set of inlet structure steel is required including hoop bars of varying diameter at mouth of conduit

STATION	SPACING OF TRANS BARS
6+08 to 6+50	8"
6+50 to 6+90	6"
6+90 to —	4½"

Omit shear bars from Sta 6+00 to Sta 6+90

SECTIONAL ELEVATION OF CONDUIT

SHOWING CHANGE FROM CUT AND COVER SECTION TO TUNNEL SECTION

SCALE ~ ⅜" = 1'

Added 4/20/39

REINFORCED CONDUIT SECTION

STATION 6+08 TO 6+90

SCALE ~ ½" = 1'

LOCATION OF HOLES

SCALE ~ ½" = 1'

SECTION A-A

SCALE ½" = 1'

44 - ¾"⌀ C₁ Bars 10'-6" long

206 - ⅝"⌀ C₂ Bars 10'-0" long

1148 ft of 2"⌀ longitudinal bars

5 - 15 ft sections of 2" pipe

12.607 cu ft of concrete per linear foot of column

GROUTING PIPE

SCALE ~ 2" = 1'

CUT AND COVER CONDUIT SECTION

SCALE ⅜" = 1'

Added 4/20/39

CONDUIT REVISIONS
WEST FORK BITTERROOT STORAGE PROJECT
RAVALLI COUNTY

STATE WATER CONSERVATION BOARD

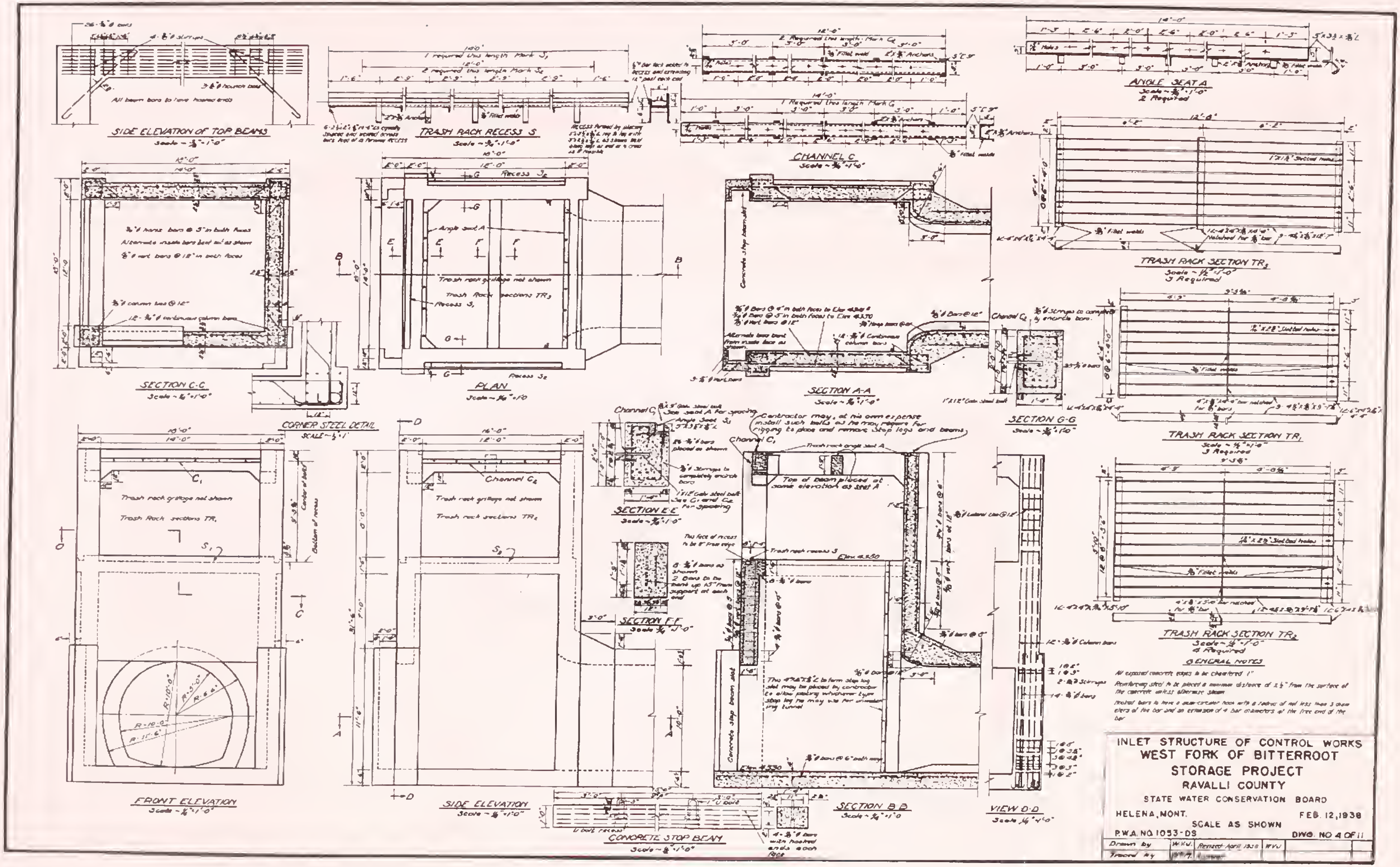
HELENA, MONTANA — NOV 30 1938

SCALE AS SHOWN

PWA NO 1053 D3 — DWG NO 5A & 5B

Drawn by	HJ	Revised 1/30/39	CS	Revised 10-31-39	RCH
Traced 12-8-75	JPS				

5-251-B



GENERAL NOTES

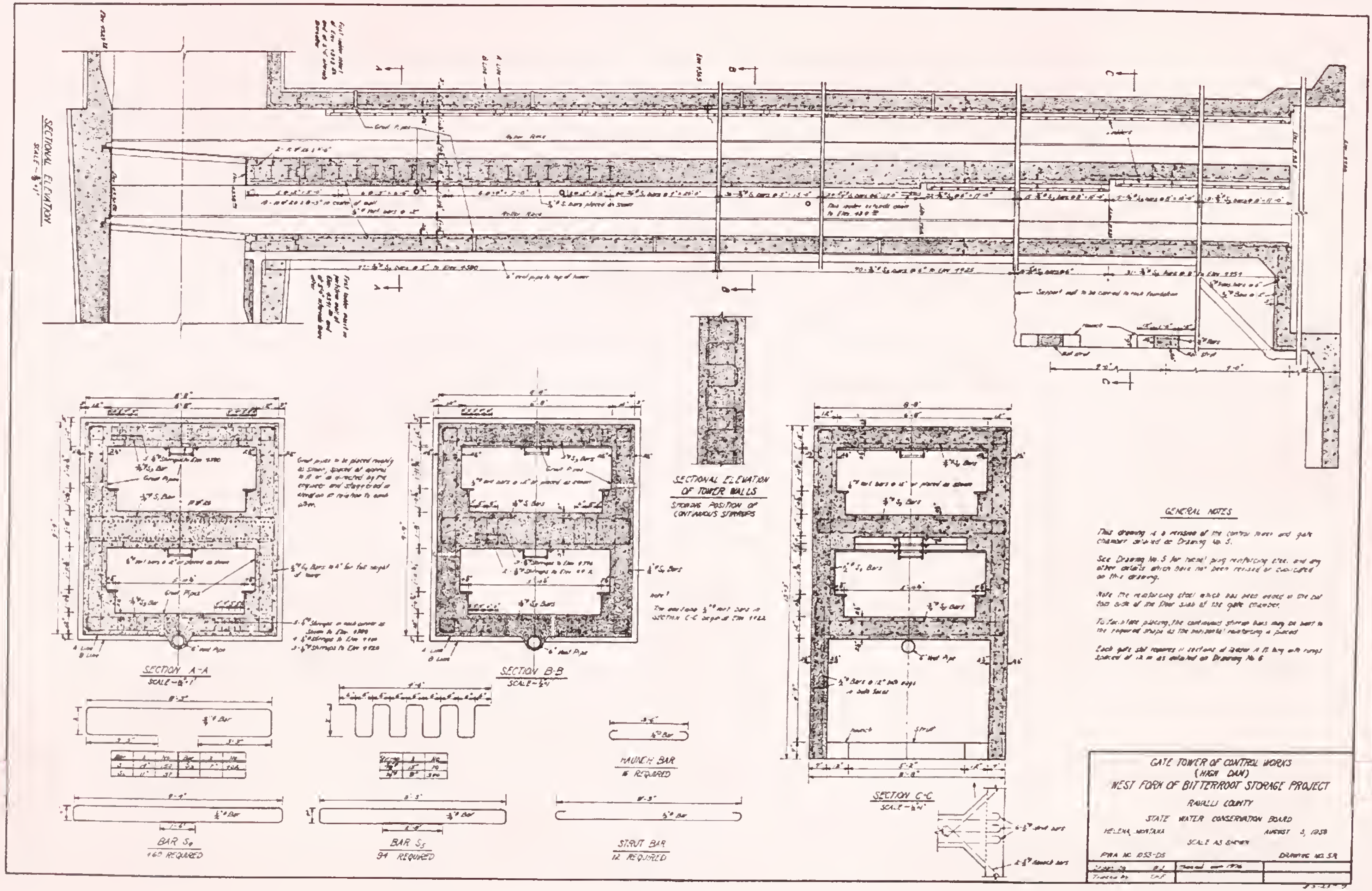
All exposed concrete edges to be chamfered 1"

Reinforcing steel to be placed a minimum distance of 2½" from the surface of the concrete unless otherwise shown

Hooked bars to have a semi-circular hook with a radius of not less than 3 diameters of the bar and an extension of 4 bar diameters at the free end of the bar

INLET STRUCTURE OF CONTROL WORKS
WEST FORK OF BITTERROOT
STORAGE PROJECT
RAVALLI COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONT. FEB. 12, 1938
SCALE AS SHOWN
P.W.A. NO. 1053-DS DWG. NO 4 OF 11

Drawn by	W.V.J.	Revised April 1938	W.V.J.		
Traced by	W.V.J.	[illegible]			



GENERAL NOTES

This drawing is a revision of the control tower and gate chamber detailed on Drawing No. 5.

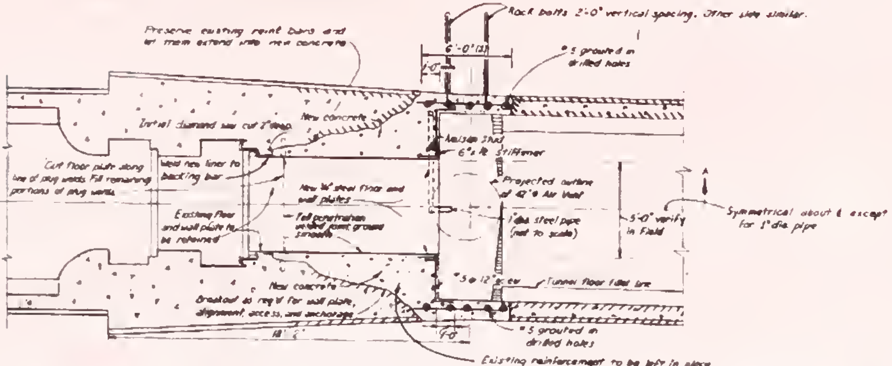
See Drawing No. 5 for tunnel plug reinforcing steel, and any other details which have not been revised or duplicated on this drawing.

Note the reinforcing steel which has been added in the bottom side of the floor slab of the gate chamber.

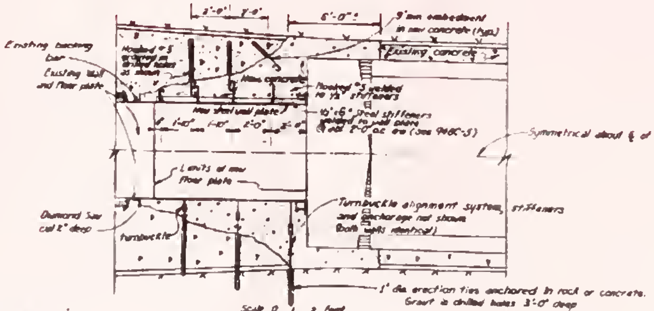
To facilitate placing, the continuous stirrup bars may be bent to the required shape as the horizontal reinforcing is placed.

Each gate slot requires 11 sections of ladder 4 ft long with rungs spaced at 12 in as detailed on Drawing No 6.

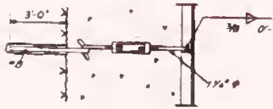
GATE TOWER OF CONTROL WORKS
(HIGH DAM)
WEST FORK OF BITTERROOT STORAGE PROJECT
RAVALLI COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONTANA
AUGUST 3, 1938
SCALE AS SHOWN
PWA NO. 1053-DS
DRAWING NO. 5R


Rock bolts 2'-0" vertical spacing. Other side similar.
Preserve existing reinf. bars and let them extend into new concrete
6'-0" (3)
1'-0"
#5 grouted in drilled holes
Initial diamond saw cut 2" deep
New concrete
Nelson Stud
6" x ⅜ Stiffener
Cut floor plate along line of plug welds. Fill remaining portions of plug welds
Weld new liner to backing bar
New ⅜" steel floor and wall plates
Projected outline of 42" ø Air Vent
Existing floor and wall plate to be retained
Full penetration welded joint ground smooth
1" dia. steel pipe (not to scale)
5'-0" verify in Field
Symmetrical about ℄ except for 1" dia pipe
#5 @ 12" ac ew
Tunnel floor fillet line
New concrete
Breakout as req'd for wall plate, alignment, access, and anchorage
18'-2"
1'-0"
#5 grouted in drilled holes
Existing reinforcement to be left in place and bent if necessary
A
A

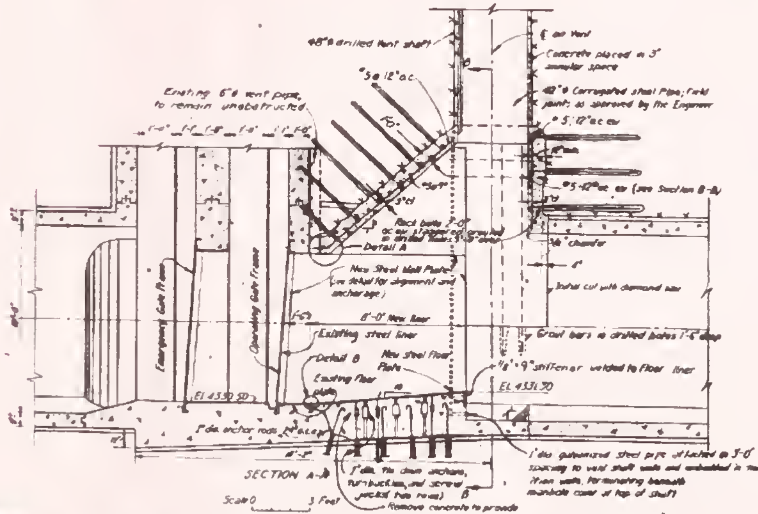
REMODELED TRANSITION-PLAN
(Details and Concrete Anchorage Not Shown)
Scale 0 3 Feet


2'-0" 2'-0"
6'-0" ±
9" min embedment in new concrete (typ.)
Existing backing bar
Hooked #5 grouted in drilled holes as shown
Existing wall and floor plate
New concrete
Existing concrete
Hooked #5 welded to ½" stiffeners
New steel wall plate
1'-10" 1'-10" 2'-0" 2'-0"
½" x 6" Steel stiffeners welded to wall plate & all 2'-0" o.c. ew (See 946C-5)
Symmetrical about ℄ of tunnel
Limits of new floor plate
Diamond Saw cut 2" deep
Turnbuckle
Turnbuckle alignment system, stiffeners and anchorage not shown (Both walls identical)
1" dia erection ties anchored in rock or concrete. Grout in drilled holes 3'-0" deep
Scale 0 1 2 Feet

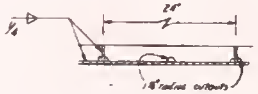
WALL ANCHORAGE AND STEEL LINER
(For steel liner details see Dwg 946C-5)



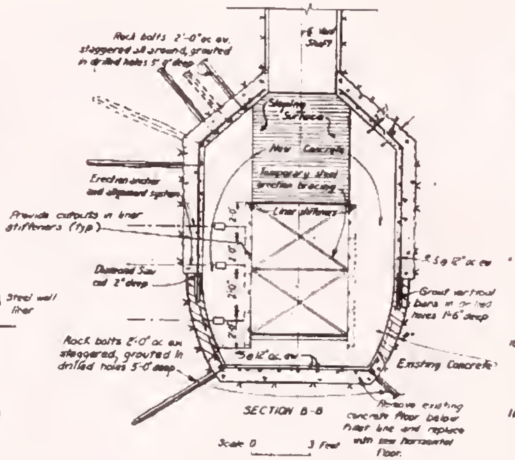
Turnbuckle Anchorage


48" ø drilled Vent shaft
℄ on Vent
Concrete placed in 3" annular space
#5 @ 12" o.c.
42" ø Corrugated steel Pipe; field joints as approved by the Engineer
#5 @ 12" ac ew
Existing 6" ø vent pipe, to remain unobstructed
1'-0" 1'-1" 1'-8" 1'-6" 1'-1" 1'-0"
5'-0"
3" cl
Rock bolts 2'-0" ac ew staggered and grouted in drilled holes 5'-0" deep
Detail A
#5 @ 12" ac ew (see Section B-B)
¾" chamfer
New Steel Wall Plate (see detail for alignment and anchorage)
Initial cut with diamond saw
Emergency Gate Frame
Operating Gate Frame
8'-0" New liner
Existing steel liner
Grout bars in drilled holes 1'-6" deep
Detail B
New steel floor Plate
Existing floor plate
⅛" x 9" stiffener welded to floor liner
EL 4330.50
EL 4331.70
1" dia. anchor rods 12" a.c.e.p.
1" dia. tie down anchors, turnbuckles, and screw jacks (two rows)
1" dia galvanized steel pipe attached @ 3'-0" spacing to vent shaft walls and embedded in transition walls, terminating beneath manhole cover at top of shaft
Remove concrete to provide access for jack and tie down anchor installation
B

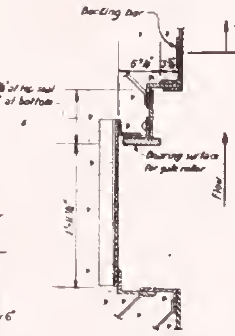
SECTION A-A
Scale 0 3 Feet



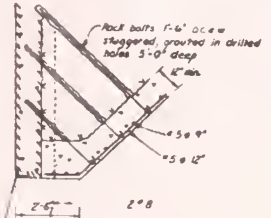
Stiffener Cutouts


4'-6" Vent Shaft
Rock bolts 2'-0" ac ew. staggered all around, grouted in drilled holes 5'-0" deep
Sloping Surface
New Concrete
Temporary steel erection bracing
Erection anchor and alignment system
Liner stiffeners
Provide cutouts in liner stiffeners (typ)
Diamond Saw cut 2" deep
#5 @ 12" ac ew
Grout vertical bars in drilled holes 1'-6" deep
Rock bolts 2'-0" ac ew staggered, grouted in drilled holes 5'-0" deep
#5 @ 12" ac ew
Existing Concrete
Remove existing concrete floor below fillet line and replace with new horizontal floor.
Scale 0 3 Feet

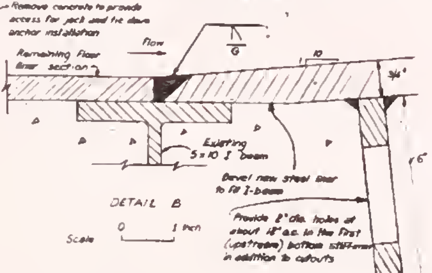
SECTION B-B


Backing bar
Steel wall liner
6⅝"
10⅝" at top seal 6" at bottom
Bearing surface for gate roller
Flow
1'-4⅝"

DETAIL OF GATE FRAME
Scale 0 1 Foot


Rock bolts 1'-6" o.c.e.w staggered, grouted in drilled holes 5'-0" deep
12" min.
#5 @ 9"
#5 @ 12"
2'-6"
2" θ

DETAIL A
Scale 0 1 2 Feet


Flow
G
Remaining floor liner section
10
¾"
Existing 5 x 10 I beam
Bevel new steel liner to fit I-beam
6"
Provide 2" dia. holes at about 18" o.c. in the first (upstream) bottom stiffener in addition to cutouts

DETAIL B
Scale 0 1 Inch

NOTES:

1. Seams in wall and floor plates between new and existing steel liner shall be welded with full penetration V welds. The finished welds shall be ground smooth.
2. All other welds shall be ¼" fillet welds unless noted on the drawings or otherwise directed.
3. Insets or offsets in existing plug welds shall be filled or ground smooth as directed by the Engineer.
4. Rock bolts shall be 1" ø hollow, groutable reinforcing bars connected to hooked bars with threaded couplers.
5. Liner plates shall be shop assembled to check fit of plates and dimensions before shipping. Erection bracing shall be bolted to gusset plates or angles tack welded to liner sections. All tack welds shall be ground smooth after concreting the liner.
6. All existing and new parts to be welded shall be cleaned of rust before welding.
7. See Specification for tolerances.
8. Do not paint any metals.
9. Contractor shall check dimensions and geometry of existing steel liner before detailing or fabricating new liner.
10. Steel liner erection scheme shown (bracing, screw jacks, turnbuckles) represent one mode. The Contractor can propose improvements to assure proper alignment and support during concreting, for which he is responsible.
11. After the Contractor has poured concrete behind the steel tunnel liner he shall inject a non-shrink grout through the liner to plug any gaps between the liner and concrete due to shrinkage during curing.

MONTANA PROFESSIONAL ENGINEER'S LICENSE NO. 4017 E

JACK C. JONES

DATE	LETTER NO.
DWG. TRANSMITTAL	

	BY	DATE	CHKD.	DATE
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REV. NO.	DATE	NATURE OF REVISION	BY	CHKD.	APPR.

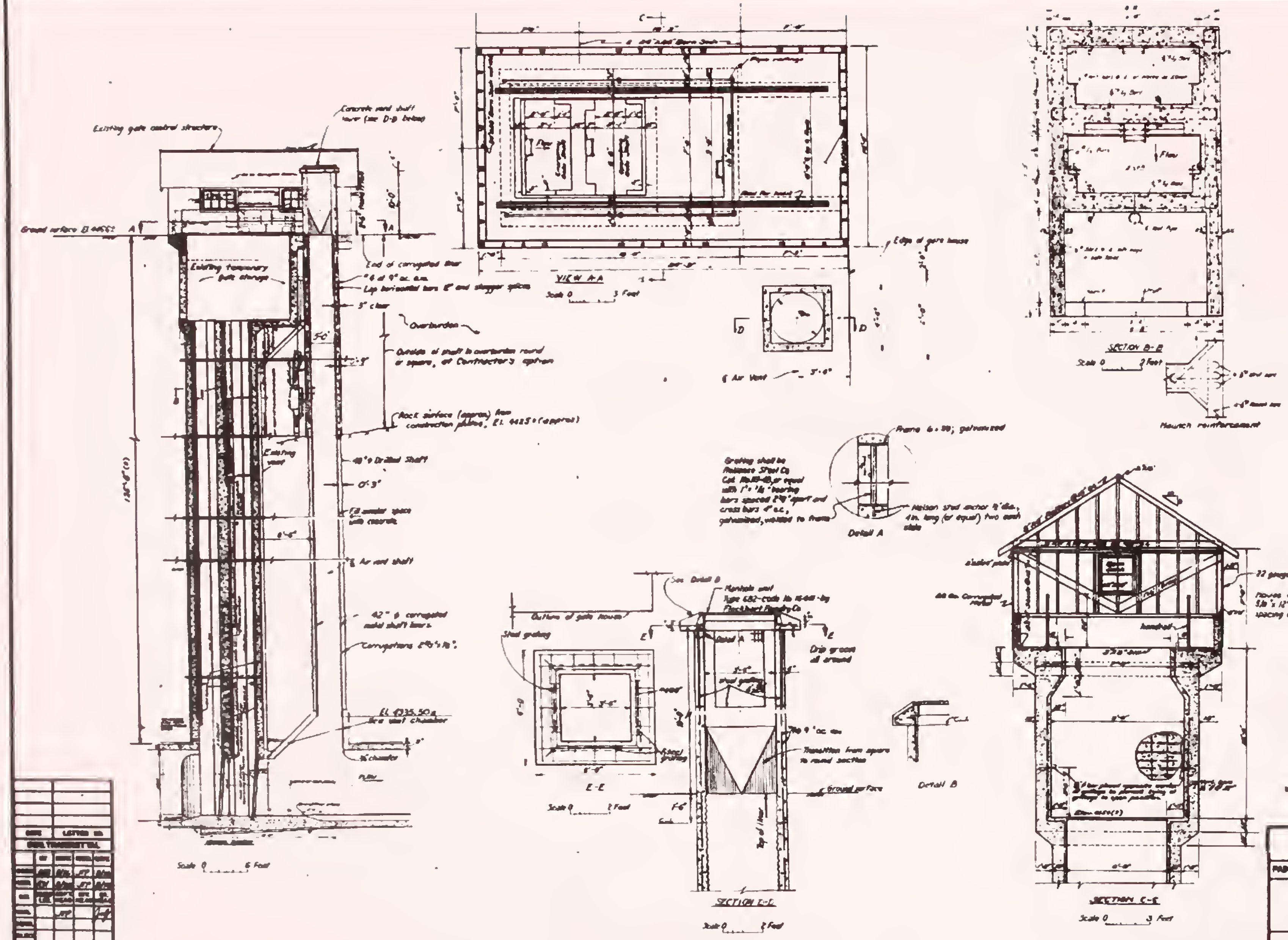
MONTANA DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION

PAINTED ROCKS DAM OUTLET | MODIFICATIONS

REMODELED TUNNEL
SECTIONS AND DETAILS

HARZA ENGINEERING COMPANY
APPROVED
CHICAGO, ILLINOIS
DATE SEPT. 1978
DWG. NO. 946 B-4

S-257-41


Existing gate control structure
Concrete vent shaft tower (see D-D below)
Ground surface El 4465±
Existing temporary gate storage
End of corrugated liner
#6 at 9" o.c. e.w.
Lap horizontal bars 8" and stagger splices
3" clear
Overburden
Outside of shaft in overburden round or square, at Contractor's option
Rock surface (approx) from construction photos, El 4425± (approx)
48" ø Drilled Shaft
0'-3"
Existing vent
Fill annular space with concrete
℄ Air vent shaft
42" ø corrugated metal shaft liner
Corrugations 2⅔"x½"
El 4335.50±
See vent chamber
¾" chamfer
Flow
Scale 0 6 Feet
VIEW A-A
Scale 0 3 Feet
Edge of gate house
℄ Air Vent
5'-0"
SECTION B-B
Scale 0 2 Feet
Haunch reinforcement
Frame 6 x 30; galvanized
Grating shall be Reliance Steel Co Cat. No. 19-4B, or equal with 1" x ⅛" bearing bars spaced 2 3/16" apart and cross bars 4" o.c., galvanized, welded to frame
Nelson stud anchor ½" dia., 4 in. long (or equal) two each side
Detail A
See Detail B
Manhole seat Type 682-code to 16-48-by Flockhart Foundry Co.
Outline of gate house
Steel grating
Detail A
Drip groove all around
Transition from square to round section
Ground surface
Top of liner
E-E
Scale 0 2 Feet
SECTION D-D
Scale 0 2 Feet
Detail B
22 gauge corrugated metal
House anchored with ⅝" x 12" bolts at spacing of about 4'-0"
handrail
SECTION C-C
Scale 0 3 Feet

NOTES:

1. The air vent shaft must be inclined at an angle of about 8.48° from vertical to intersect the tunnel crown. The Contractor shall determine the exact angle required in the field.

MONTANA PROFESSIONAL ENGINEER'S LICENSE NO. 4917 E

JACK C. JONES

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

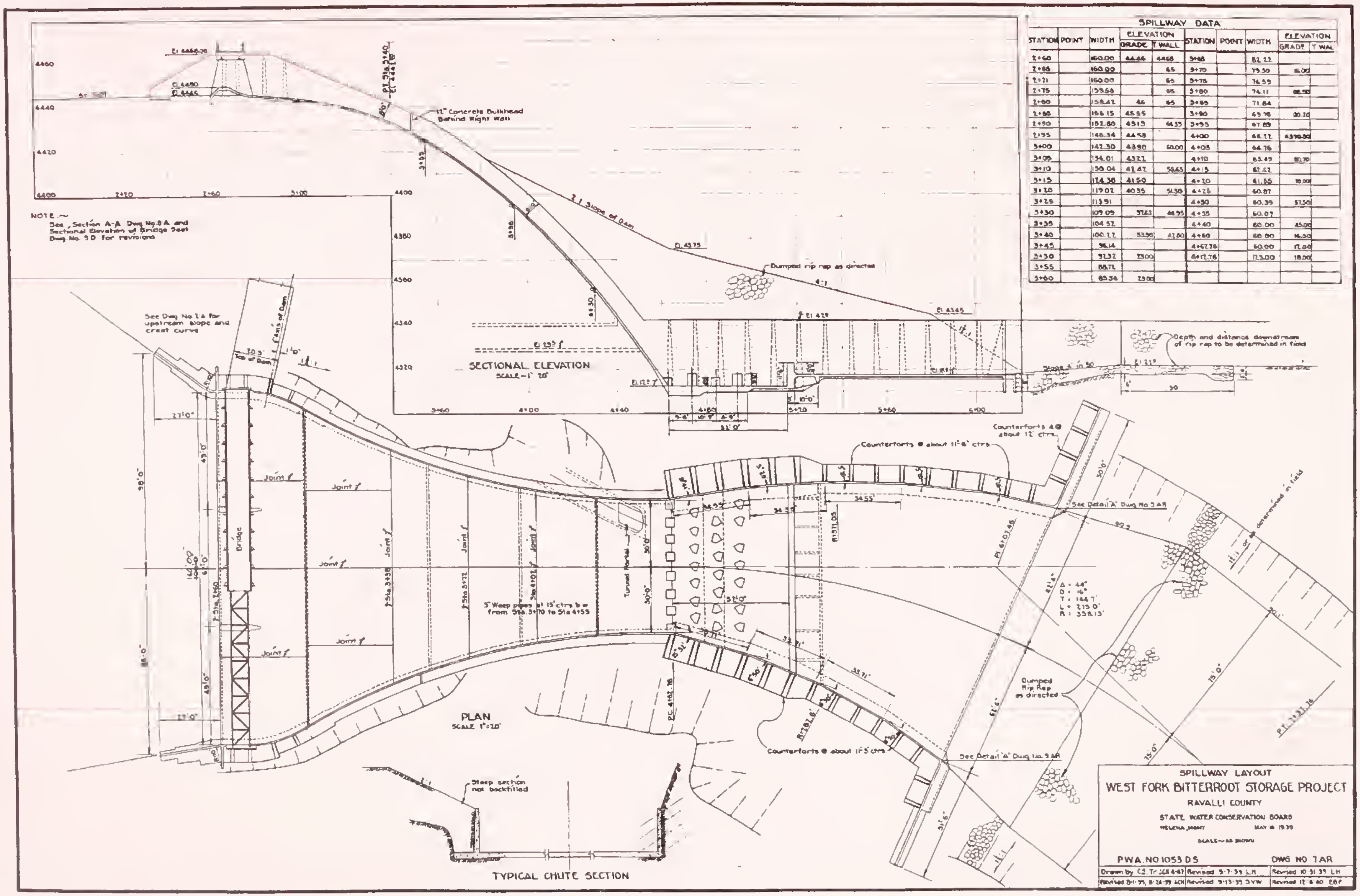
PAINTED ROCKS DAM OUTLET | MODIFICATIONS

TUNNEL VENT SHAFT

HARZA ENGINEERING COMPANY
APPROVED Jack C. Jones

CHICAGO, ILLINOIS | DATE SEPT 1978 | DWG. NO. 946 C-3

5-867-78



NOTE.–
See, Section A-A Dwg No 8 A and Sectional Elevation of Bridge Seat Dwg No 9 D for revisions

SPILLWAY DATA

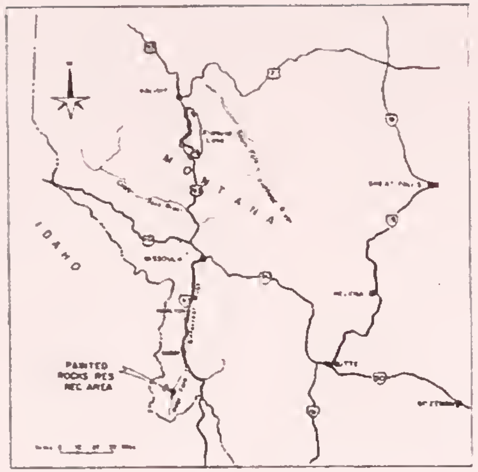
STATION	POINT	WIDTH	ELEVATION		STATION	POINT	WIDTH	ELEVATION	
			GRADE	T WALL				GRADE	T WALL
2+60		160.00	44.46	4468	3+68		82.22		
2+66		160.00		65	3+70		79.30	16.00	
2+71		160.00		65	3+76		76.59		
2+75		159.68		65	3+80		74.11	08.50	
2+80		158.42	46	65	3+85		71.84		
2+85		156.15	45.55		3+90		69.78	00.20	
2+90		152.80	4515	44.35	3+95		67.89		
2+95		148.34	4458		4+00		66.22	4390.00	
3+00		142.30	4390	60.00	4+05		64.76		
3+05		136.01	4322		4+10		63.49	80.70	
3+10		130.04	42.42	56.65	4+15		62.42		
3+15		124.38	4150		4+20		61.65	10.00	
3+20		119.02	4035	51.30	4+25		60.87		
3+25		113.91			4+30		60.39	57.50	
3+30		109.09	37.63	48.95	4+35		60.07		
3+35		104.52			4+40		60.00	45.00	
3+40		100.22	33.90	42.80	4+50		60.00	16.00	
3+45		96.14			4+67.76		60.00	12.00	
3+50		92.32	23.00		6+12.76		125.00	18.00	
3+55		88.72							
3+60		85.34	23.00						

SPILLWAY LAYOUT
WEST FORK BITTERROOT STORAGE PROJECT
RAVALLI COUNTY
STATE WATER CONSERVATION BOARD
HELENA, MONT. MAY 10 1939
SCALE – AS SHOWN

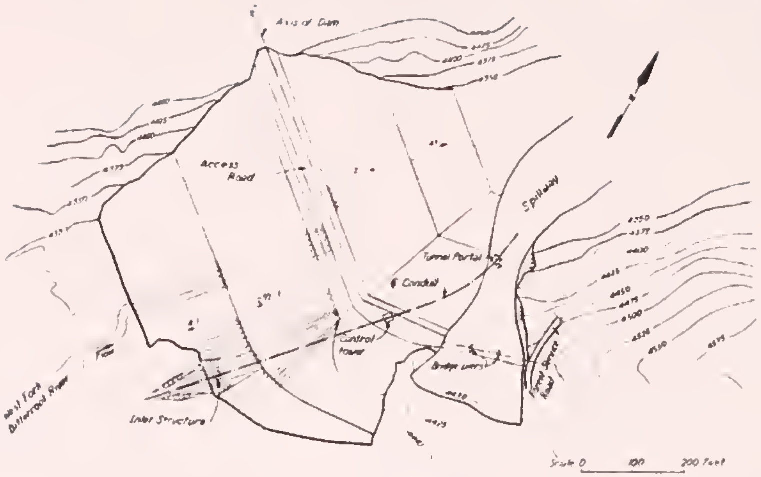
PWA. NO 1053 DS DWG NO 7AR

Drawn by C.J. Tr JCR 4-41	Revised 5·7·39 L.H.	Revised 10·31·39 L.H.
Revised 8·1·39, 8·24·39 ACH	Revised 9·13·39 DVW	Revised 12·6·40 E.O.F.

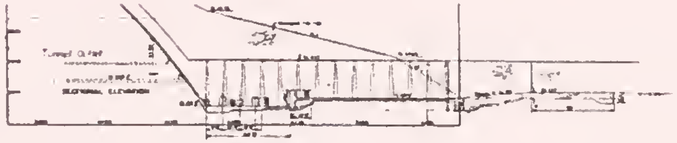
D 257·11



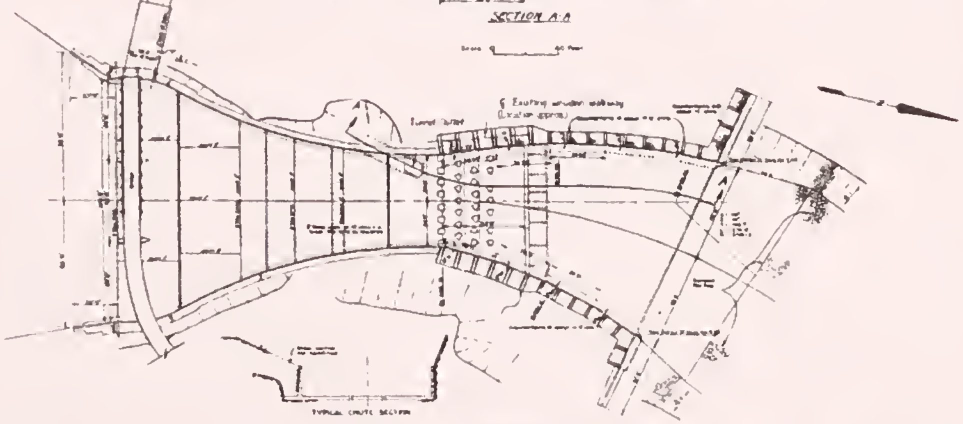
KEY MAP



SITE PLAN



SECTION A-A



SPILLWAY PLAN

MONTANA PROFESSIONAL ENGINEER'S LICENSE NO 4917 E

JACK C JONES

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

PAINTED ROCKS DAM OUTLET | MODIFICATIONS

LOCATION AND ACCESS

HARZA ENGINEERING COMPANY
APPROVED

CHICAGO, ILLINOIS

REV NO.	DATE	NATURE OF REVISION	BY	CHKD.	APPD.

DATE	DWG NO
SEPT 1976	946 G-1

S-257-38

DATE	LETTER NO.			
DWG. TRANSMITTAL				
	BY	DATE	CHKD	DATE
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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CIVIL		[illegible]		[illegible]
MECH				
ELECT				
PLAN				
STAFF		ENGINEER		